JUL 12 1960

TRAFFIC QUARTERLY

AN INDEPENDENT JOURNAL FOR BETTER TRAFFIC

JULY 1960

Motorist Abroad
Regional Planning Agency
Cleveland's Neighborhood Parking
Freeway Performance in Los Angeles
Efficient Metropolitan Transportation
Protecting Our Highway Investment
Accident Experience in Chicago
The Transit Industry Dilemma
Chicago's Traffic Planning
Limited Access Highways
D. C. Traffic Safety

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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Traffic Quarterly

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Motorist Abroad

A tour of duty in Europe some years ago and recently a three-months vacation there provide an opportunity to make some observations on traffic. Traffic problems are much the same as our own, confusion and congestion.

We have toured parts of Italy, Switzerland, and France. Our itinerary, dictated partly by nostalgia, has been pleasant and enjoyable.

In all three countries, the increase in improved highways, motor travel and cars was noticeable. City traffic is sluggish, often at a stand-still, and hopelessly confused. It nonetheless offers some indication or assurance of increasing prosperity.

Small cars, large efficient buses, heavy trucks with an unusual number of bicycles and motorcycles, create an insurmountable problem for the traffic police. American cars are the exception. Driving is fast and close, characteristic of the small car's dashing in and out of the traffic lanes.

We motored repeatedly over mountain roads, not without thrills, in the area of Naples and Salerno, through Ravello, Sorrento, Amalfi, Positano, and Herculaneum, then on as far as the twenty-five-century-old Greek temples at Paestum. The serpentine highways in this historical area are a credit to modern highway engineering.

In Italy, traffic deaths correspond closely to our own. Motorists drive nervously in sudden starts and stops, always unpleasantly rushing, appearing to consider a miss as good as a mile. Though pedestrians and bicycles have the right of way, they use it largely at their own risk.

In scenic Switzerland, once the home of Byron, most of our travel and interest centered on the Jungfrau and the Matterhorn, heavily covered in April with deep snow and skiers who had come from many parts of Europe and America to pursue their skill in this invigorating climate.

The Swiss have about a third of the well-known high mountains of Europe. They have made them accessible, profitable and productive through their engineering skill, abundance of electrical power, and a fortunate avoidance of the ravages of war.

The mountain slopes are dotted with attractive chalets and prosperous-looking villages. Every available slope and plain is meticulously cultivated and generally irrigated. Geneva, the center for many world organizations, has an international flavor.

Our travel in France began at the southern end of Lac Léman to visit again the historically famous church of Bron, in Bourg en Bresse, reflecting the vicissitudes of past centuries and from there to the valley of the Loire and the châteaux, centuries old but living monuments to past French history and the luxuries of its royalty.

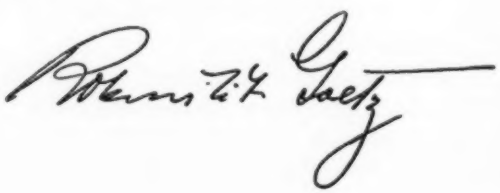
On these interesting trips by motor, there was always occasion for casual traffic observations. Traffic in the cities and country is fast, for their small cars, and often reckless. Impatience appears to be its principal characteristic. In the cities, police are patient and courteous but overwhelmed.

Taxicabs are not permitted to cruise. They have authorized stands at the curb and in formerly beautiful squares, originally planned as sites for historical monuments. Use of the horn is severely restricted, a noticeable relief that contributes to better driving. It deserves a trial in our cities. Nothing contributes more to the innate impatience of the average driver than the senseless, often impertinent use of his horn.

Throughout our travel, it appeared that Europe has made the most of its attractions by providing good roads to reach them with good food and pleasing accommodations along the way—often in contrast to our own attractions, so frequently bordered by unattractive signs and structures obscuring the pleasant countryside.

One cannot travel in Europe and remain unaware of the people's pride in their history, their struggles, and their monuments, which keep their memories alive. It is a tribute that many of our explorers, statesmen, scholars and heroes deserve, one we should cultivate.

And last, we visited Omaha Beach. Our National Cemetery there is sad but impressive as a monument to our ideals.



A Regional Planning Agency For Southeastern Wisconsin Area

GOVERNOR GAYLORD NELSON

Gaylord Nelson is serving his first term as governor of the State of Wisconsin. He was a state senator for ten years prior to his election to state-wide office in 1958. While in the state senate he represented the metropolitan area of Wisconsin's capital city, Madison. He was a leader, while in the legislature, for action in behalf of metropolitan and regional problems.

PLANNING, a thankless job, produces criticism and resentment among many directly affected. Yet it is undoubtedly one of the most important tasks of government. It may well be the most important domestic function. If America is spared the ravages of war, the kind of life that future citizens enjoy will depend to a great extent upon the efforts of planners.

The planner of Milwaukee's great park system, Charles Whitnall, is remembered with reverence. Those parks have become a part of the way of life in Milwaukee. What kind of industrial morass would Milwaukee be without them? There are many other examples of farsighted planning, unappreciated in their day, that have made cities great, or, in failure, have destroyed them.

Planning is a European concept, and still is regarded by many as un-American. It is perhaps a contravention of the traditional American pioneering spirit, the untrammeled, wasteful exploitation of natural resources that was possible and profitable in the days when there was an unexplored frontier. But the factor that made planning necessary in Europe long ago is now making it necessary in the United States. It is the planner who is the pioneer today. That factor is population. No one likes to face the facts of population growth, and no one likes to pay its price. But this fact must be faced, and the price must be paid. And unless Americans plan now to meet the problems that growth brings, the price will be higher.

Wisconsin has been trying to do this kind of planning at the state level. There are more people with more cars and with more

time for recreation and with better highways, while there are only so many lakes, rivers and forests. And many of the cities in Wisconsin have had planning programs, some of them highly successful in their day. These programs, for the most part, involved planning within a governmental unit with arbitrary, artificial boundaries. It was evident some years ago that planning which stopped at the city limits was inadequate.

PLANNING AT THE STATE LEVEL

But the problem this posed was difficult. Extension of planning brought planners into conflict with local pride, disruption of settled ways of life, economic advantage and vested interests. These conflicts remain.

Consider the meaning of the phrase—"the outskirts of town." It is in universal use in this country; it connotes shanties, trash heaps, garish, cheap commercial ventures, physical and moral squalor. It represents the failure to carry planning to its proper limits, and the inability to solve the political problems that this kind of planning brings. For planning is a political problem. It is a political problem even within the limits of a city. Political problems constitute the primary obstacle to the success of the work of Wisconsin's Metropolitan Study Commission in Milwaukee County. It is the paramount problem confronting those who have been so bold as to attack the problem of regional planning.

An individual with the total power in his own hands would have little difficulty in planning successfully. But the price of this kind of planning is more than most want to pay. However, planning can succeed within the framework of democracy, and it has; England affords examples. But it is far from easy. How to persuade the inhabitants of a region to see that some regional interests are more important to them than their narrow municipal interests; how to stimulate imagination to perceive the long range benefits than can accrue from regional planning, especially when the short range effect might be unpleasant from a neighborhood or individual view; how to overcome the competitive jealousies of rival cities or villages. These are some of the problems faced in attempting to do regional planning. These are problems expressed in terms of political opposition.

The automobile is probably the most important reason for the decentralization of cities. It has made labor mobile. It has spread homes forty and fifty miles from the place of work, scattered subdivisions in the middle of farm areas, changed cottage areas to commuter zones, provided an incentive for industries and other businesses to move to the country. It has made a mess of many areas outside cities. It has resulted in pollution of streams and lakes, created new knots of traffic congestion, lowered water tables and boosted property tax rates to the sky as influxes of families with children created new needs for schools. Without planning, changes like these take place so swiftly that residents despair.

FACTORIES AND TRAFFIC IN THE COUNTRY

Local governments struggle with these problems, usually in vain. Zoning ordinances are enacted. Subdivision control ordinances regulate development in limited areas. But most of these efforts come too late, and most of them control neighborhoods too small in area to have any real effect. The resulting hodgepodge development is resented by the older inhabitants of the area, who want to avoid changing their ways. It is disappointing to the newer residents, who fled crowded city areas for suburban life, only to discover that factories, traffic and slums have followed them into the country.

These are the disheartening aspects of life in sprawling urban areas such as the seven-county region of southeastern Wisconsin, an area that contains Milwaukee, Racine, and Kenosha. Planning can do much to forestall these developments. Planning can preserve natural beauty, and there is a great deal of natural beauty to preserve. Planning can spread the school tax burden, screen the factories from the homes, preserve the water table, stave off pollution and provide for efficient movement of traffic.

The people are going to continue to pour into areas such as this. Make no mistake about that. Some persons would like to try to prevent this, but they cannot. They can, however, through planning, provide that the influx will be orderly. The way of life will change, if growth is planned, but it will not be destroyed. There are advantages in regions like southeastern Wisconsin. One of them is industrial prosperity. Properly viewed, prosperity is regional rather than municipal. Southeastern Wisconsin will be prosperous, for this rel-

atively small, crowded area is the heart of Wisconsin's industrial strength, and the whole state's prosperity depends on the area.

When industrialists look at the potential labor supply in this region, boundary lines are ignored. There are Walworth county residents who work in Milwaukee, Ozaukee county residents who work in Kenosha. There will be even more of this mobility as highways improve. Some day the rivalries between communities in southeastern Wisconsin will be considered laughable. Today, however, they constitute a serious impediment to joint action. An example is the Bong air base site, recently abandoned by the U. S. Air Force after an abortive construction start. Advisers have thought that the best use of that area probably would be for industrial development, and the governor's office has offered suggestions to the national government along that line.

This may or may not turn out to be the best use for this area, but it certainly is a possibility worth exploring. The criterion for the decision on the use of the Bong site should be regional prosperity; foolish fears that the site might attract an industry from one of the cities in the region, or that an industry which might locate at Bong might have located in another city should not stand in the way of Bong's development. If Bong is prosperous, Milwaukee will be prosperous, and so will Racine and Kenosha.

BACKGROUND OF RIVALRY

It is against this background of intra-regional rivalry and political difficulty that Wisconsin is trying to establish a regional planing agency in its southeastern, seven-county region. This area, containing the industrial and commercial muscles of the state, has a population of 1,535,700 in a land area of 2,628 square miles; it is the fastest growing portion of Wisconsin, and is described as the "hot corner." It contains nearly half the state's taxable property and generates far more in state taxes than it requires in state services.

Quite apart from the specific problems to which regional planning would direct its energies in this area, an operating agency would have several goals and tasks:

1. There is great need to co-ordinate the application of state programs and policies within this region. Commonly, each agency of state government operates with parochial vision, apparently unconcerned about the

capacity of its program to mesh with programs of other agencies. There is typically no central co-ordination or broad policy for program execution within the region. The following oft-quoted statement made by an assistant attorney general in a 1951 meeting of the Wisconsin Natural Resources Committee of State Agencies illustrates the problem:

"I have been caught in the cross-fire between agencies on a great many occasions, in problems in the use of water for recreation, power, irrigation, and particularly now of drainage in respect to potatoes. . . . In these different problems, you will have one case when the Department of Agriculture tells farmers to go ahead and dam up the streams to get water to grow potatoes, the conservation commission says leave it alone, it is a beautiful spot. The soil conservation (committee) program is trying to preserve the land for their purposes . . . (Professor) Penn (University of Wisconsin) urges irrigation . . . the public service commission wants a dam built."

Partially related to state activities is the paramount need for regional transportation planning that will integrate and co-ordinate development of highways, expressways, airports, harbor facilities, mass transit, rail and bus transport, and trucking. Scores of agencies presently work at regional transportation, but often at cross purposes for want of regional policies, information, and plans. Fractured transportation planning is expensive to government at all levels, and to business, industry, private individuals and the transportation companies. Equally important, the absence of regional planning tends to retard economic expansion through failure to correct area-wide transportation disadvantages.

2. Every region needs an official agency that can articulate its goals and development objectives to state and national governmental agencies. Equipped with penetrating studies and well-thought-out plans, a regional planning agency can speak with intelligence about state highway locations, wetlands preservation, parks development, and pollution and watershed control.

3. Particularly essential is the need for a regional agency that can co-ordinate the separate and conflicting activities of municipalities within the region. This is especially evident in such public works fields as sewerage, storm water drainage, water supply, highway construction, parks, airport development, and flood control. The line shot by a surveyor's transit before the Civil War has little bearing on shifts in population, economic structure and municipal service requirements.

4. There is for southeastern Wisconsin a poverty of economic and ecologic base data and studies of land use and development capacities that can be tapped by the utilities, governmental agencies, industrial and commercial firms, and developers. The sustained collection, analysis, and pub-

lication of such information is an appropriate and vital function of a regional planning agency. Before any regional industrial development program can get under way, for example, four basic tasks foundational to planning must be executed:

(a) An inventory must be made of the basic facts of the region gained through unbiased examination of the region's water, power, fuel, manufacturing, transportation, labor training, manpower, and other resources.

(b) An awareness must be articulated of economic trends of the region and an evaluation made of long-term local and regional income and market patterns and technological trends for specific industries.

(c) Differential costs analysis must be executed, that is, the determination of the difference in regional costs of fuel and power, water, raw materials and supplies, transportation, labor and capital investment for each particular project.

(d) Final selection must be made of the types of industry that can most logically locate in the communities of the region on the basis of lower production and distribution costs, market growth potential or other particularly favorable operating conditions.

It is evident that all of this basic research for industrial development depends on regional concepts.

5. In communities too small or without sufficient funds to maintain planning staffs or retain consultants, a regional agency can extend assistance on local master planning, subdivision control and zoning. Local assistance work should be handled in moderation, however, since this kind of work frequently causes a regional agency staff to dilute its energies and overlook its broader regional objectives.

These tasks find their ultimate expression in a regional general plan that treats all relevant aspects of regional development on an area-wide basis. Specifically, the elements of the plan should include:

1. A general land use plan that establishes principal land use configurations. Such a plan must be based on a series of thoughtful economic and ecologic base studies and a comprehensive land use inventory.

2. A related general transportation plan that treats all aspects of transportation, from highways to port development to airport construction.

3. A public facilities plan that includes parks, water supply, sewerage, drainage, schools, hospitals, and other facilities.

4. A natural resources program with emphasis on water, land, forests and wildlife.

5. A capital improvements program containing recommendations to

appropriate governmental agencies about the timing and level of capital spending required to meet the regional plan targets.

6. A program of sustained liaison and consultation with constituent local units to give the daily advice and information required in general plan implementation.

The suggested general regional plan, it should be stressed, is not a rigid master plan. Instead, it is a fluid expression of regional goals; it is a process and a framework for regional development. The elements underpinning the general plan need continued re-evaluation, and the economic and other studies foundational to it require constant revision. New circumstances, new problems and unforeseen opportunities will emerge, and the general planning process must be capable of embracing these. In southeastern Wisconsin, a regional planning agency will have several immediate problems, in addition to the tasks previously listed:

Initially, concentrated attention will have to be given the problems of metropolitan sprawl, with its uneconomic, unattractive consequences. Secondly, there is the problem of development of a disposition plan for the 5,500-acre Bong air base site in Kenosha and Racine counties. Upon cancellation of construction contracts, the region had suddenly thrust upon it problems of drainage control, loss of tax base and future land use. Third, there is the task of developing a north-south circumferential expressway around metropolitan Milwaukee, and of planning a new industrial highway linking the lakeshore counties. Fourth, completion of the St. Lawrence Seaway has brought new patterns of traffic and trade and new opportunites for economic development. Finally, there is need to develop co-operation with the recently created Northeastern Illinois Regional Planning Commission for the solution of mutual problems confronting metropolitan Lake Michigan industrial centers.

Southeastern Wisconsin now has the statutory framework for creation of an effective regional planning agency. Under 1955 legislation improved by the 1959 legislature, the governor is empowered to create a regional planning agency following petition of a local governing body within the region, a public hearing, and consent of governing bodies representing fifty percent of the equalized taxable property within the region. In the case of the proposed

seven-county agency, each of the seven-county boards would appoint one member of the commission, and the governor would appoint seven, half of whom have "experience in local government in elective or appointive offices or who are professionally engaged in advising local governmental units in the fields of land use planning, transportation, law, finance or engineering." Once established, the commission would derive its budget from property taxes not exceeding .003 percent of the equalized value of the constituent units.

To date, three of the seven counties, representing 79.9 percent of the regional equalized property value and 78.8 percent of the regional population, have petitioned for creation of an agency. Establishment of a commission for southeastern Wisconsin, regardless of its precise boundaries, thereby appears assured.

City-Owned Parking in Cleveland for Neighborhood Shoppers

COMMISSIONER ROBERT J. KELLY

Commissioner Kelly is Commissioner of Traffic Engineering and Parking at Cleveland, Ohio. Previously, from 1948 to 1955, he practiced traffic engineering in Chicago. From 1953 to 1955, he was Superintendent of Parking there, from the beginning of the Parking Program.

MUNICIPAL parking programs have been developing throughout the United States in the last fifteen years. The increasing need for off-street parking in urban areas has been established. Probably the greatest reason for off-street parking is the increasing demand for curb-to-curb right-of-way for moving traffic.

The means of satisfying the need varies. It has also been fairly well established that governmental agencies should enter the picture to a greater extent than in the merely advisory capacity sometimes suggested. The federal government, most state governments and almost all city governments are, in fact, in the parking business. Courts have almost always insisted that governmental parking facilities are for the necessary police powers of regulating and enforcing traffic and zoning rules for the general welfare.

Greatest pressure against municipal parking has come from private parking operators' agencies. In some instances, actions by those groups have harassed, even cancelled municipal parking programs.

In all cities, the parking industry is a *downtown* business. Since supply and demand determine rates, there will always be *some* parking available downtown. However, private industry doesn't seem to be interested in the neighborhood areas where the rates for parking are traditionally low, yet where the need is now becoming more acute and little or no parking exists as an industry. There is the paradox.

Most of the governmental parking programs have been on a city or metropolitan level. These programs have been developed,

financed and administered in several ways. Chicago, Detroit, San Francisco, Denver, New York, and others have used revenue bonds. Most of those bonds have been guaranteed by parking meter revenues. Other cities—Buffalo, Cleveland, and Kansas City—have used general obligation bonds.

Other plans range from straight meter funds to benefit assessments. The benefit assessment was one of the first methods attempted to pay for off-street parking. A few cities tried it; few have been successful. No method is more difficult; particularly because of the inequitable determination of "benefit." There is no way to satisfy every participant. Some who pay the least complain the most. The man across the street claims that he derives less benefit than the man on the same side of the street even though they are equally distant from the lot. In an average neighborhood lot, it requires negotiation with as many as fifty property owners. It is nearly impossible to get agreement among this many persons.

NEIGHBORHOOD PARKING NEEDED

In Cleveland, we evolved a program with some new twists. It appears complicated because it takes an idea from each of several methods. In the Cleveland parking program policy, the first premise is that there is far greater need for municipal off-street parking in the neighborhood shopping areas than in the central business district. Although more adequate parking will improve the economic health of a downtown area, it is not the whole answer. Even without adequate parking, the central business district can count on the customers from mass transit and are guaranteed business from the captive market of people working downtown or coming downtown for other errands.

In Chicago, it has been noted by the Chicago Association of Commerce and Industry and the Chicago Planning Commission that only twelve percent of the shoppers in the downtown area come only to shop. In other words, seventy-eight percent of the downtown business comes from persons who either work downtown or come for some other primary purpose. Downtown, today in our large cities, is no longer primarily a shopping district, but rather a hub for the professions' central offices and many varied activities.

In neighborhood areas, this parking condition is more critical.

Shopping areas within the older sections of the city grew up gradually. Most of the retail stores were built on arterial streets in three- or four-block strips. For years, the curb parking in these areas was available and reasonably adequate. Then the parking meter came along and temporarily created more curb parking by increased turnover. Relief was short as vehicle registration continued to soar.

Now most of these arterials are needed to move traffic, not only in the rush hour, but often throughout the day. So neighborhood areas must either buy land for off-street parking or go out of business. Most of the neighborhood merchants don't have sufficient capital to buy land. Generally, the neighborhood store is a marginal business with little capital beyond its equipment and stock. If a downtown department store has its parking troubles, it has many remedies. Consequently Cleveland set a higher priority on aid to the little merchant with parking problems.

Now for some *answers:*

In 1950, Cleveland's first bond issue (general obligation) of one million dollars for parking was passed by the electorate. Again in 1952, Cleveland issued two million dollars more. To date there have been seven million dollars worth of general obligation bonds.

For five years the parking program floundered, looking for a formula far reaching, equitable, and not a burden to the general taxpayer. Parking revenue bonds could have been used but guaranties would have to come from either meters or downtown parking. In 1955, through considerable study by Mayor Celebrezze and several interested neighborhood retail property owners, we hit upon a rather unique formula.

CLEVELAND'S FINANCING METHOD

The city puts up all the money, from G.O. bonds, for the land acquisition and the improvement. Before the city begins any lot, it first requires an agreement from all *abutting* commercial property owners to assume two-thirds the cost of the whole project (See Figure 1). This agreement spells out the amount each property owner must pay as an assessment against his property for twenty years. We call it an assessment, because the amount will appear on the tax duplicate. (See Table I.) Actually another way to figure it is that each commercial property owner abutting the parking

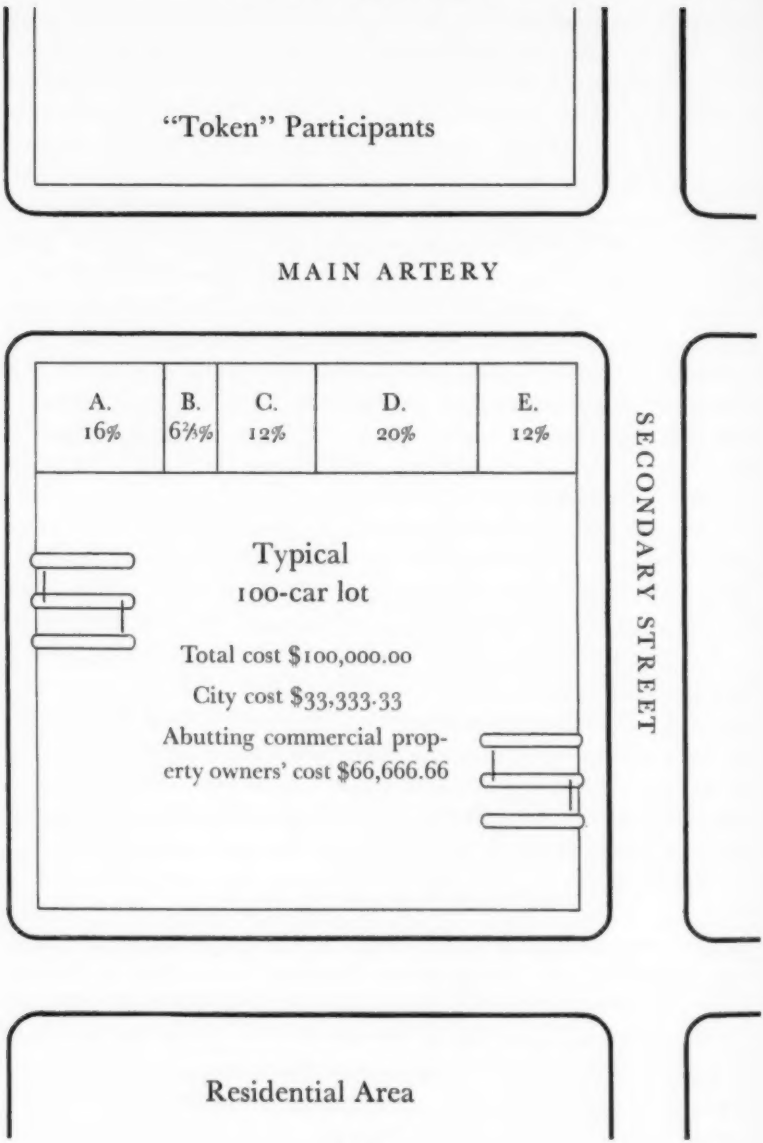

"Token" Participants
MAIN ARTERY
A.
16%
B.
6⅔%
C.
12%
D.
20%
E.
12%
Typical
100-car lot
Total cost $100,000.00
City cost $33,333.33
Abutting commercial property owners' cost $66,666.66
SECONDARY STREET
Residential Area

Figure 1

Automatic Parking for Neighborhood Shoppers

lot pays yearly one-twentieth of his share of two-thirds the cost of the lot. His share is determined by the foot-front method along the parking lot. The lot always remains city property.

TABLE I

Property Owner	%	*Total Assessment*	*Annual Share*
A.	16	$16,000.00	$ 800.00
B.	6⅔	6,666.66	333.33
C.	12	12,000.00	600.00
D.	20	20,000.00	1000.00
E.	12	12,000.00	600.00

After the parking lot is completed, the city leases the lot to abutting commercial property owners. They must operate at a profit under close supervision of the city. Usually the parking charge is nominal because neighborhood lots are economically submarginal. From this gross parking revenue, all operating expenses are paid. The operating expenses include lighting, taxes (in Ohio we pay taxes on municipal parking lots), snow removal, part-time attendant, sweeping.

After operating expenses are met, the profit is split one-third to the city and two-thirds to abutting property owners in the same proportions as their assessment. If the net revenue payment to any individual property owner should exceed the amount of his yearly assessment, it must be paid against his 20th-year assessment. This is to keep the program in the best public interest.

It is interesting to note that the federal department of internal

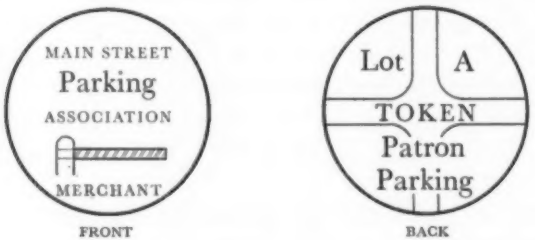


Figure 2. These are sold to merchants for eight cents. Exit from lot would cost patron ten cents. Good advertising: "Park free—Shop here!"

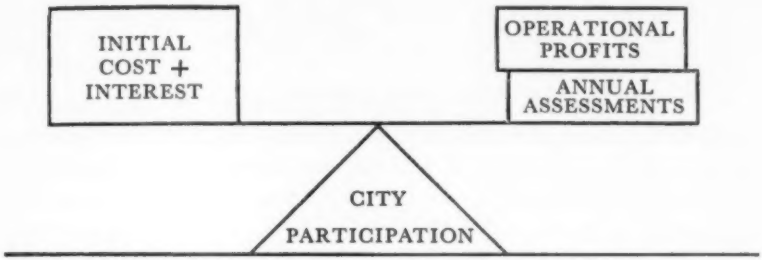
revenue has ruled that these assessments are deductible as a yearly business operating expense. From a letter dated May 21, 1958 and signed by Don T. Ferris, acting director, tax rulings division of the department of internal revenue:

> Upon the basis of the information submitted (City of Bismark, North Dakota), it is the conclusion of this office that the assessments described constitute allowable deductions by taxpayers engaged in a trade or business in the area involved as ordinary and necessary business expenses under Section 162 of the Internal Revenue Code of 1954, provided the taxpayer can show that such payments are reasonable, bear a direct relationship to his business and are made with a reasonable expectation of a financial return commensurate with the amount paid.
>
> Since the question is a factual one, final determination will be made by the appropriate field office after examination of the return of any taxpayer claiming the deduction.

When you look at this financing method on the yearly basis, it is less difficult to sell to the commercial property owner. For example, in Table I, lot owner D has a twenty-year assessment of $20,000, an annual assessment of $1,000. If you compare this yearly $1,000 with the operation and amortization expenses of a privately owned lot, it is a good business deal.

Cleveland began this phase of its parking program in 1958. Since its beginning, five neighborhood lots have been completed and there are ten more in the negotiation stage. With only six months' operating experience completed, it is difficult to determine how closely operating expenses and amortization cost will be met. However, it is important to note that these lots do *not* have to be economically feasible as is the case in a revenue bond program. We hope to get all of the city's bond money back within twenty years under this program. But if we do not, the primary purpose of the lot is to relieve traffic congestion and assist a neighborhood with parking shortage.

On the first lot for the first six months' operation, we find we are receiving sufficient revenue to pay all operating expenses and taxes with a little left over for amortization payments to the city and the abutting property owners. Most of these commercial property owners know it is unlikely they will receive *all* their money



City Treasury	City Treasury
SPENT ON LOT	INCOME FROM LOT
$100,000.00 Plus Interest	1. Annual assessments @$3,333.33 Total $66,666.66 2. Operational profit ? 3. City owns property

back. Their attitude is that so long as the operating expenses are paid and they have the parking lot they will receive an adequate return on the assessment through business. Any additional return will, in reality, only offset their yearly assessment.

MERCHANTS ISSUE PARKING TOKENS

All of the lots in the neighborhood shopping areas are operated by automatic parking gates. The present fee is ten cents, pay as you leave. There is a four-hour limit to keep the all-day parker out. The operating agency is made up of the abutting commercial property owners. It is to this group that the city leases the lot. This operating agency then sells parking tokens (Figure 2) to the merchants in the area.

Many merchants in the area whose property does not abut the lot have nevertheless benefited. These benefiting merchants do not participate in the assessment, but they pay as much or more for the lot through distribution of parking tokens. Furthermore, their use of the subsidy or token scheme is almost compulsory because the merchants occupying the abutting property issue tokens.

The abutting property owner is purchasing these parking tokens from the operating agency of which he is part—taking the money out of one pocket and putting it in the other after operating expenses. Since the abutting merchant receives a share of profit from the tokens he purchases, he encourages the use of tokens throughout the area. Since the parking lots are generally situated behind the largest stores, the smaller merchant goes along with the token plan. Everyone benefited really contributes.

Eventually, through the law of supply and demand, all benefited merchants contribute equitably. Some merchants near the lot declined at first to buy tokens. Days later, they asked to buy tokens. Most of the merchants say they feel that the $10 or $20 a week for tokens is a good investment and a legitimate business expense, a fair return through additional customers.

The neighborhood customer would rather shop here than in a new suburban shopping plaza for two reasons: He's dealing with the old merchant he's known for years and he's "getting something for nothing" on the token scheme. He's unconsciously obligated to the merchant with no increased cost of merchandise. Soon after a

new parking lot is built and the token system is operating, we restudy the arterial streets in the area with the objective of removing as much parking as possible. Thus the original plan to clear the streets for moving traffic is fulfilled.

The reaction of the small merchant to the entire program has been positive, the results gratifying. Many merchants pay for the tokens out of their advertising budget. Some indicate that increased business enables them to carry the token expense and advertise also. A side effect is the stimulation of the local merchants in the solidarity of an association. From a purely social group it has grown to a strong organization working on advertising and sales ideas.

Here, then, is a parking program that has put the government unobtrusively in a position to help the little merchant find his boot straps.

Evaluating Freeway Performance In Los Angeles

PAUL T. MCELHINEY

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DUE to intensive metropolitan development in the United States, many of our modern cities face the problem of moving unprecedented volumes of traffic through their streets—basically, people and goods.

The traffic volume, however, is greatly affected by the types and sizes of vehicles chosen. The characteristics of the Los Angeles area have been conducive to the selection of automotive vehicles and a system of individual rather than mass transportation. The choice of the freeway as a device for moving traffic is based upon the premise that the local problem is essentially one of moving large numbers of vehicles rather than one of moving individual persons or shipments. For a little more than a decade the California Division of Highways has been engaged in an intensive program of freeway construction in the Los Angeles area. Perhaps one-fifth of the network of superhighways contemplated for the future has now been completed; another twenty years will be required to construct the remainder. The purpose of this article is to evaluate the freeway system in terms of the objectives for which it was conceived.

Insofar as possible, current data in this discussion are representative of the year 1958. Since construction is continually in progress,

Figure 1.

the size of the freeway system is never static. This makes it necessary carefully to relate data to a cutoff date.

THE LOS ANGELES FREEWAY SYSTEM

The status of the system in the summer of 1958 is shown in the map in Figure 1. At that point in time, about 120 miles of the network were complete. Five major portions, the Harbor, Hollywood, Pasadena, San Bernardino, and Santa Ana Freeways, had been in use long enough for considerable traffic data to have been developed. These five freeways are shown in heavy black lines on the map and converge in or near the four-level interchange structure in downtown Los Angeles.

At the cutoff date these facilities were all full freeways with complete control of access. They featured separation of traffic streams and grade separations at all intersections. The Harbor and Hollywood routes were of eight-lane construction while the other three facilities carried six lanes each.

OBJECTIVES OF THE LOS ANGELES FREEWAY SYSTEM

Problems of vehicular traffic have long been a matter of concern to city planners in the Los Angeles area. Due to the large number of political jurisdictions involved, many agencies, both governmental and civilian, formal and informal, have done research and made recommendations about street and highway transportation in metropolitan Los Angeles.

The network of super-highways developing in the area today is not the result of a single plan made all at once by some one official organization. Nor is there in existence any official "master" plan which visualizes a rigid overall system. Projects have been undertaken pretty much in response to the most desperate local needs for better ways of moving huge traffic volumes. Regardless of this situation, local urban planners have long stressed the need for a logical scheme of limited-access highways in the area. Considerable progress has been made toward establishing a well-planned set of facilities.

The parts of the freeway system which the division of highways has constructed conform closely to routes recommended in a series of unofficial plans made by interested civic groups beginning as early as 1924.

Although space does not permit discussion of the many reports, they were carefully analyzed in this study to reveal the objectives that planners had in mind for the limited-access highways.[1]

An assumption implicit in each of the reports was that population growth and economic development of metropolitan Los Angeles would continue at a high rate. The stated or implied thesis of each freeway proposal was that the existing street system was already overcrowded and that provision must be made to handle the future traffic bound to develop.

It was foreseen that increased traffic on ordinary streets would decrease ability to perform land-service or land-access functions. By the end of World War II it was obvious that this was happening, and that roads and streets generally were carrying a greater amount of traffic than they had been designed for.

Also common to these studies was the fear that as congestion built up, driving time between points of the city would increase substantially, the implication being that it was already excessive. At least three comprehensive surveys were undertaken to measure "typical" driving times between points in the Los Angeles area. The role of traffic interference and impedance of flow in causing delay was emphasized.

Finally, the high automotive accident and fatality rates of the area were attributed to the heavy traffic using the streets and the complex relationship of many opposing traffic streams and many different vehicle types.

Perhaps indicative of the spirit of the Californians who produced these planning reports is the fact that they did not particularly fear

1. Some of the most important planning reports affecting the Los Angeles freeway system are the following:

A Major Traffic Street Plan for Los Angeles, Traffic Commission of the City and County of Los Angeles, (Los Angeles: 1924).

A Comprehensive Rapid Transit Plan for the City and County of Los Angeles, Kelker, De Leuw and Company, (Chicago; 1925).

Report of a Highway Traffic Survey in the County of Los Angeles, The Regional Planning Commission, County of Los Angeles, (Los Angeles: 1937).

Traffic Survey of Los Angeles Metropolitan Area, 1937, Automobile Club of Southern California, (Los Angeles: 1937).

A Transit Program for the Los Angeles Metropolitan Area, City of Los Angeles, Transportation Engineering Board, (Los Angeles: 1939).

Interregional, Regional Metropolitan Parkways, Los Angeles Metropolitan Parkway Engineering Committee, (Los Angeles: 1946).

The California Freeway System, California Department of Public Works, Division of Highways, (Sacramento: 1958).

that failure to reduce the above factors would hamper the economic development of the Los Angeles area. Future growth they were certain of; efficient operation of the metropolis was their primary concern.

A summary of the achievements thus expected of the freeways system may be stated as follows:

1. Establishment of sufficient capacity in the street and highway system of metropolitan Los Angeles to provide for future traffic development and to improve the land service or access functions of the existing street system.

2. Elimination of delays caused by interruptions of the traffic stream. This would not only reduce journey times between parts of the city but would reduce traffic density by improving flow.

3. Reduction of the street accident and fatality rate.

The first link in a set of super-highways which should accomplish the above objectives was the Arroyo Seco Parkway, opened December 30, 1940.[2] This highway is now known as the Pasadena Freeway. World War II prevented much progress on the remainder of the system until 1945. Between that year and the present, substantial mileage has been built and much experience in freeway operation has been gained.

The various agencies concerned with freeway construction, maintenance, and regulation have assembled much data descriptive of this experience. Although each has used its data extensively, there have been little integration and comparative analysis of the various sets of statistics available. The present study, therefore, involves such an assembly and comparison of old and new data in order to evaluate Los Angeles freeway performance against each of the objectives set forth above.

THE OBJECTIVE OF CAPACITY

No pronouncement of the early planners in the area was more true than their prediction that populations of people and automobiles would grow at an astounding rate. Their prediction of the potential growth of the traffic problem represented in the increase of these factors has already been pointed out. Although the traffic flows of Los Angeles were heavy and complicated just before freeway

2. *The Arroyo Seco Parkway*, California Department of Public Works, of Division Highways, (Los Angeles: 1940).

construction began, they have become much greater and more complex during the decade in which the present system has been developed.

The following analysis measures the extent to which the parts of the existing system have provided room to handle the traffic which has developed. In addition, it tests whether or not traffic has been removed from adjacent surface streets to let them better perform land service or access functions. This treatment also allows consideration of the extent of overcrowding on surface streets before freeway construction, whether the freeways handle more traffic than did their parallel facilities, and the extent to which the freeways themselves are overcrowded.

MAJOR TRAFFIC STREETS

Prior to 1924, Los Angeles suffered from a system of narrow, disconnected surface streets. A study into the causes of street congestion, made in that year, recommended a general program of street widening and straightening.[3] A county-wide gridiron of large arterial streets was developed from the recommendations of this study.

Today, these streets have from four to six lanes, are fully signalized, and intersect each other approximately every eight blocks throughout the Los Angeles area. Experience from many years of traffic counts has led the City of Los Angeles Traffic Department to figure the practical capacity of major traffic streets at 650 vehicles per lane per hour.[4]

Before the freeway, these streets carried the bulk of the traffic load. In fact, each of the previously described freeways has replaced a surface street route so that comparison between more or less parallel major traffic streets and freeway facilities is possible in each case. In some instances, conditions on major traffic streets were so bad prior to freeway opening that they were almost impassable during rush hours. Vehicles sometimes waited, bumper to bumper, for as long as thirty minutes while traffic cleared.[5]

The advent of the freeways relieved these streets of much of the

3. *A Major Traffic Street Plan for Los Angeles, op. cit.*

4. Information obtained from Survey Division, Traffic Department, City of Los Angeles.

5. Information obtained from Mr. E. T. Telford, Assistant State Highway Engineer in charge of District VII, California Division of Highways.

traffic they were carrying. Table I indicates the extent. The technique used is to describe the freeway and its alternate route, present traffic counts for the alternate route previous to freeway opening, and traffic counts for both facilities after that time.

A rough statement of the practical daily operating capacity of both the streets and the freeways can be obtained. In the case of the streets, the calculation is simply to multiply the 650-an-hour figure by the number of lanes available and to extend it to cover the entire twenty-four hour period.[6]

According to this system, the surface streets in question (with the exception of South Figueroa) had a practical operating capacity of about 26,000 vehicles a day. As can be seen in Table I, this was being greatly exceeded in all cases before freeway construction. When these freeways were opened, traffic volume on the surface streets dropped to well below their capacities.

What is perhaps even more significant, although the volume on the freeways themselves has increased substantially since the openings (nearly double), surface street volume has remained below capacity. Only the route paralleling the Pasadena Freeway has increased its load to exceed the pre-freeway level.

As may be seen in Table I, the freeways themselves have since become overloaded.[7] As the existing 120 miles of completed freeway represent only a small part of the projected system, much of this overloading will be relieved as extensions and parallel routes are completed.

The surface street situation is particularly significant as it shows that the freeways have handled almost the entire new traffic growth in recent years. This has allowed the surface streets to operate at an almost stable volume.

THE OBJECTIVE OF REDUCED DRIVING TIME

As the various urban centers of the Los Angeles metropolitan area have grown and developed, their interests have become more

6. For purposes of estimation, local officials generalize that a peak hour will produce about 10 percent of total daily traffic in the usual situation. Thus, practical operating capacity for one hour may be expressed as 10 percent of total daily capacity.

7. The freeway capacity figures shown in the table are based upon the findings of George Webb and Karl Moskowitz as published in "California Freeway Capacity Study, 1956," *Highway Research Board Proceedings*, Vol. 36, 1957. These authors generalized that an "acceptable operating volume" for a six lane freeway is 1565 vehicles per lane, per hour; for an eight lane, 1575.

TABLE I—COMPARISON OF AVERAGE DAILY TRAFFIC CARRIED BY SURFACE ROUTES AND MAJOR LOS ANGELES FREEWAYS BEFORE AND AFTER FREEWAY OPENINGS

THOUSANDS OF VEHICLES PER TWENTY-FOUR HOUR PERIOD

Facilities		*Before Freeway*	*After Freeway*	*Now*
South Figueroa Street	(1955)	45,713		
A.D.T. Capacity 39,000	(1956)		15,634	
Comparable route to	(1958)			13,542
The Harbor Freeway				
A.D.T. Capacity 126,000	(1956)		93,480	
	(1958)			160,522
Sunset Boulevard	(1950)	35,016		
A.D.T. Capacity 26,000	(1952)		18,512	
Comparable route to	(1958)			20,856
The Hollywood Freeway				
A.D.T. Capacity 126,000	(1953)		76,764	
	(1958)			144,020
North Figueroa Street	(1940)	24,298		
A.D.T. Capacity 26,000	(1941)		18,849	
Comparable route to	(1958)			25,637
The Pasadena Freeway				
A.D.T. Capacity 93,900	(1941)		33,622	
	(1958)			82,097
Valley Boulevard	(1953)	23,540		
A.D.T. Capacity 26,000	(1954)		16,898	
Comparable route to	(1958)			20,346
San Bernardino Freeway				
A.D.T. Capacity 93,900	(1954)		49,432	
	(1958)			105,971
Telegraph Road	(1953)	38,126		
A.D.T. Capacity 26,000	(1955)		17,770	
Comparable route to	(1957)			19,720
The Santa Ana Freeway				
A.D.T. Capacity 93,900	(1954)		65,414	
	(1958)			92,319

Sources: California, State Highway Engineer, *Annual Traffic Counts*, Sacramento: published annually. Los Angeles, City Traffic Department, data abstracted from original worksheets of traffic counts by the author. Los Angeles, County Road Department, *Traffic Counts*, Los Angeles: 1958.

and more interrelated. If the area is to function as an urban unit instead of a collection of small municipalities, communication and transportation between the parts must be swift and dependable.

The various groups who studied pre-freeway transportation in the Los Angeles area were concerned that increasing congestion might make the desired relationship difficult. Thus, freeways were

expected to improve the situation. The conclusion that they have done so needs no qualification.

The limited access characteristic of the freeway, of course, gives it a tremendous speed advantage over the conventional street. Since there are no conflicts between opposing traffic streams, speed limits may be allowed which are the same as those for a rural highway. Surface streets, on the other hand, are still limited by cross flows at intersections, and a mixed traffic of pedestrians and all sorts of vehicles. Safety demands that they be governed by traffic signals and relatively low speed limits.

Since 1930, five speed and delay studies of journey-time have been made on Los Angeles streets. Sponsoring organizations have been the Regional Planning Commission, The Automobile Club of Southern California, and the California Division of Highways.

In most of the studies, the driving method used was what is known as the "floating car" technique. The survey vehicle attempts to accompany the "average" traffic stream, neither accelerating beyond the group nor lagging behind. Probably the most successful use of this technique has been accomplished by the Traffic Department of the Division of Highways. The department employs both a driver and an observer in the test vehicle. The same driver is used for all the runs in each study to eliminate variations between drivers. The observer is equipped with a stop watch recording device.

Table II presents a limited amount of the data collected in three of these studies. It compares the journey-times attainable over surface street and parallel freeway routes for the pre-freeway period of 1936-1937 and the post-freeway period of 1956-1958.

The table gives elapsed time for trips between specific street intersections. The data have a fair degree of statistical accuracy because of the large number of observations from which they were drawn. The 1936-1937 figures are averages of the results of several runs over each route. The 1956-1958 studies involved many trips over each freeway and street studied. For purposes herein, the median measurement at each checkpoint was selected from the latter reports.

Although they were not specifically intended to be peak hour measurements, most of the 1956-1958 observations were taken between 6 A.M. and 9 A.M., and between 3 P.M. and 7 P.M. These two

TABLE II—COMPARISON OF ELAPSED DRIVING TIMES ON SURFACE ROUTES AND MAJOR LOS ANGELES FREEWAYS BEFORE AND AFTER FREEWAY OPENINGS

TIME SHOWN IN MINUTES AND SECONDS

Route	*STREET* 1936–1937 Studies	*STREET* 1956–1958 Studies	*FREEWAY* 1956–1958 Studies
South Figueroa Street			
vs.	17:	12:41	5:50
The Harbor Freeway			
From Civic Center to Santa Barbara Avenue			
Sunset Boulevard			
vs.	20:	N.A.	7:35
The Hollywood Freeway			
From Civic Center to Hollywood and Vine Streets			
Figueroa St.–York–Fair Oaks Boulevards			
vs.	31:	21:48	10:30
The Pasadena Freeway			
From Civic Center to Glenarm Street			
Valley Boulevard			
vs.	31:	21:41	12:51
San Bernardino Freeway			
From Civic Center to Rosemead Boulevard			
Olympic Boulevard–Telegraph Road			
vs.	37:	35:13	16:40
The Santa Ana Freeway			
From Civic Center to Norwalk Boulevard			

Sources: Automobile Club of Southern California, *Traffic Survey Los Angeles Metropolitan Area, 1937*. Los Angeles, County Regional Planning Commission, *Highway Traffic Survey in the County of Los Angeles, 1937*. California, Division of Highways, *Reports of Speed and Delay Studies*, (various freeways, 1956–1958, unpublished).

periods include both the usual morning and afternoon peak hours. This somewhat enhances the value of the latter studies for comparative purposes as measurements were, thus, made during periods of heavy traffic.

As may be seen in the table, the freeways now offer a considerably shorter trip-time than their parallel streets did or do now. There is apparently some improvement in the running time over the streets themselves. This latter gain cannot all be credited to the freeways, however. At least a small part of the variation is due to difference in statistical technique in the earlier and later studies. Then there has been much improvement in the vehicles and the traffic control systems on the surface streets since 1936.

Two things about the way the freeway has accomplished the goal of reduced driving time are significant. First, high average speeds and short average trip-times are possible even though the facilities are operating at more than practical capacity.

Second, the speed performance of the system is generally uniform. Virtually the same pattern emerged in each of the comparisons presented above. These two characteristics indicate that the facilities are performing according to the planners' expectations. They are capable of moving traffic more swiftly than previous facilities. They can do it for volumes in excess of those they were designed to carry, and they can do it all over the system.

THE OBJECTIVE OF INCREASED SAFETY

Extremely high motor vehicle accident rates were experienced on the streets and highways of California until the late 1940's. Since the Los Angeles area was no exception in this situation, an important role assigned to the then projected freeway system was the reduction of injury and fatality rates.

An indication of the seriousness of the accident situation in California and Los Angeles can be gained from the data for selected years presented in Table III.

TABLE III—COMPARISON OF UNITED STATES, CALIFORNIA, AND LOS ANGELES MOTOR VEHICLE FATALITY RATES

SELECTED YEARS

	United States fatalities		*California fatalities*		*Los Angeles fatalities*	
Year	*Per 100 Million Vehicle Miles*	*Per 100 Thousand Persons*	*Per 100 Million Vehicle Miles*	*Per 100 Thousand Persons*	*Per 100 Million Vehicle Miles*	*Per 100 Thousand Persons*
1936	15.1	29.4	15.1	51.7		37.2
1939	12.1	24.9	12.7	45.2	9.5	34.8
1942	10.6	20.7	11.9	35.5	6.4	21.3
1945	11.3	21.7	15.3	40.1	9.0	27.9
1947	8.8	22.5	9.5	33.9	5.0	21.8
1948	8.1	21.9	8.1	29.2	3.4	15.5
1951	7.5	24.3	7.7	32.3	3.0	13.6
1954	6.3	22.3	6.1	24.7	2.9	14.8
1957	5.9	22.6	5.9	26.5	3.4	17.8

Sources: National Safety Council, *Accident Facts*, Chicago: published annually. Los Angeles City Police Department, Traffic Services Division, Accident Statistics (various hectographed).

Since 1947, considerable improvement has been shown. Although the California population fatality rate has remained higher than the national average, this is to be expected. The experience of traffic statisticians indicates that this is usually the case in areas enjoying a heavy tourist traffic since the rate is figured against only the static population.

The reduction in fatality rates which has taken place in Los Angeles since 1947 is impressive. Perhaps it is not fortuitous that the decrease occurred during the period in which the present freeways were constructed. All credit cannot go to them, however, as other effective forces have reduced both local and state accident rates.

In 1949, Governor Earl Warren focused attention upon the traffic safety situation by convening the first annual California Governor's Safety Conference.[8] Since that time, an integrated traffic safety program has been conducted in California. Educational, engineering, motor vehicle administrative, and legislative personnel have co-operated to work for continuing reduction of the accident rate.

Such factors as driver-education by secondary schools, driver-testing for operators' licenses, educational and preventive law enforcement, progressive revision of the state vehicle code, as well as studious improvement in engineering design have conjoined to create a safer highway situation. Resort must be had to more specific data to isolate the role of the freeway in this generally improving situation.

The City of Los Angeles Police Department records at least two series of data that allow comparisons of accident rates on freeways and surface streets. These are the number of injury accidents and the number of fatalities per 100 million vehicle miles traveled on the respective facilities. An abstract of these data for selected years appears as Table IV.

The most important conclusion to be drawn from an examination of Table IV is that the freeways produce substantially fewer injury accidents than do the surface streets. A comparison of Columns 4 and 5 of the table indicates that the freeway fatality rate is

8. *A Decade in Red*, Governor's Co-ordinating Committee of State Officials on Traffic Safety, (Sacramento: 1950).

now also slightly lower on the average. The fact must be emphasized, however, that the freeway fatality rate is lower than the surface street rate only because the number of injury accidents is much less.

The ratio of fatalities to injury accidents on the city streets was approximately one fatality for every sixty accidents in which injuries occurred. The ratio on the freeways was about one to thirty-five. Therefore, although the chances of an injury accident happening at all are much less on the freeways than on the city streets, if such an accident does occur on the freeway the chance of a resulting fatality is materially greater than on the street system. This situation is a direct result of the higher speeds which are attained on the freeway.

TABLE IV—INJURY ACCIDENT RATES AND FATALITY RATES IN THE CITY OF LOS ANGELES
FIVE MAJOR FREEWAYS vs. ALL SURFACE STREETS
SELECTED YEARS

Year	*Total Miles of Freeway Open in City Limits*	*Injury Accidents Per 100 Million Vehicle Miles*		*Fatalities Per 100 Million Vehicle Miles*	
		Street	*Freeway*	*Street*	*Freeway*
1941	5.6	227	153	9.3	5.0
1945	9.8	212	43	9.0	9.5
1948	11.7	170	54	3.4	3.4
1951	19.5	178	55	3.0	2.0
1954	25.5	176	57	2.9	2.0
1957	32.7	206	98	3.4	2.4

Source: Data of City of Los Angeles Police Department, especially *City of Los Angeles Freeway Statistics*, Los Angeles: 1958, hectographed.

A comparison of fatality rates on Los Angeles freeways and Los Angeles city streets in general is biased in favor of the streets. The street network is considerably more extensive than that of the freeway system. Accident and fatality rates differ as between streets; some are quite safe while others produce numerous accidents.

Therefore, a comparison of each individual freeway and its comparable surface street is also appropriate. Of the five freeways previously discussed, only three are located, with their comparable surface streets, principally within the City of Los Angeles proper. This limits the availability and uniformity of accident data and restricts the present examination to the Harbor, Hollywood, and Pasadena Freeways.

The historical fatality rates of these three facilities and their parallel conventional streets are compared in Table V. Insofar as possible, this table presents the accident experience of each surface route both before and after the advent of the freeway.

Although the entire present Los Angeles freeway system is probably carrying in excess of 4 billion vehicle miles annually, the amount run on any one segment of it is not sufficient to make a fatality rate per 100 million vehicle miles meaningful.

TABLE V—FATAL ACCIDENT EXPERIENCE OF HARBOR, HOLLYWOOD, PASADENA FREEWAYS AND THEIR COMPARABLE SURFACE STREETS

SELECTED YEARS

I. The Harbor Freeway Compared to Equivalent Portions of South Figueroa Street.

Year	Fatalities on Street	Fatalities on Freeway	Average Daily Traffic Street	Average Daily Traffic Freeway	Fatality to Volume Ratio Street	Fatality to Volume Ratio Freeway
1952	3		38,051		.79	
1953	4		38,578		1.04	
1954	3	1	39,150	74,040	.76	.14
1955	4	1	45,713	116,057	.88	.09
1956	3	5	15,634	124,175	1.92	.40
1957	1	6	15,500	153,228	.65	.39

II. The Hollywood Freeway Compared to Equivalent Portions of Sunset Boulevard.

Year	Fatalities on Street	Fatalities on Freeway	Average Daily Traffic Street	Average Daily Traffic Freeway	Fatality to Volume Ratio Street	Fatality to Volume Ratio Freeway
1944	14		22,033		6.35	
1947	8		33,950		2.36	
1950	1		35,106		.29	
1952	4	5	18,512	65,486	2.16	.76
1955	2	10	19,000	122,982	1.05	.81
1957	6	9	20,500	149,838	2.93	.60

III. The Pasadena Freeway Compared to Equivalent Portions of North Figueroa Street (no pre-freeway data available).

Year	Fatalities on Street	Fatalities on Freeway	Average Daily Traffic Street	Average Daily Traffic Freeway	Fatality to Volume Ratio Street	Fatality to Volume Ratio Freeway
1942	4	0	11,196	25,067	3.57	0
1945	9	7	9,014	28,136	9.98	2.49
1948	0	1	15,414	46,280	0	.22
1951	3	2	18,831	56,342	2.65	.36
1954	0	6	18,544	66,171	.98	.58
1957	4	13	27,248	71,827	1.47	1.81

Sources: Fatalities on the streets were abstracted directly from the "Dead Body" Register of the Los Angeles Police Department. Freeway fatalities from *City of Los Angeles Freeway Statistics*, Los Angeles Police Department, 1958.

Therefore, the rating device used in Table V is a "fatality to volume ratio." This is simply the number of fatalities divided by the volume with the result multiplied by 10,000 to eliminate zeros. This amounts to about the same thing as assigning each vehicle counted a constant annual mileage and therefore produces a rate very like a fatality rate per 100 million vehicle miles.

Comparing the fatality to volume ratios for streets and freeways shown in Table V indicates that in most cases the freeways have a substantially better record than the streets. The general improvement since 1947 can be noted in the streets paralleling the Hollywood and Pasadena freeways. In the cases of the Harbor and the Hollywood freeways, the reduction of volume on the surface streets does not seem to have necessarily had a beneficial effect upon their fatality rates.

In fact, special radar speed studies by the Los Angeles Police Department indicate that the reverse may be true. These studies indicate that, as volume dropped off on ordinary streets, vehicular speeds attained between traffic lights increased materially. Thus, in some cases, although the number of reportable accidents on the streets decreased, the fatalities increased due to higher speeds.[9]

It should be noted that a multiple-fatality accident on either facility materially distorts the rate. See, for instance, the year 1957 for the Pasadena Freeway.

Another observation about these figures may reflect something regarding freeway design. It will be noted that the fatality to volume ratio of the Harbor Freeway is consistently the lowest of the lot, and that of the Pasadena Freeway is the highest. It may be significant that the Harbor route is the newest facility and the Pasadena is the oldest.

The best conclusion to be drawn from Table V is that these three freeways indeed produce fewer fatalities on a mileage basis than their companion routes did or do now.

Although the freeways cannot be completely responsible, the automobile safety record of Los Angeles has improved materially since their construction was started. There is evidence to show that the limited mileage comprising the freeway system is safer than the

9. Information obtained from Traffic Services Division, Traffic Bureau, Los Angeles Police Department.

overall street system. Specific data also indicate that individual freeways are much safer fatality-wise than the routes they have supplemented.

The wide dispersion of possible journey origins and destinations around the City of Los Angeles, the long distances between them, and the low density of population have long made the area one well-suited to a system of individual transportation. As early as the 1920's, optimistic city planners foresaw that if population growth and metropolitan development followed anticipated rates, the area would someday be faced with the problem of moving huge numbers of motor vehicles. Numerous studies were made as the situation evolved, even the earliest of them pointing to a system of limited-access highways as a possible primary solution.

SUMMARY AND CONCLUSIONS

Those who proposed and planned the Los Angeles freeway system held definite hopes for what it would accomplish. One of the most important of these objectives was that the new system should establish adequate capacity for traffic that would develop in the future. The long distances between important parts of the urban area dictated that the new roadways should also function to reduce travel times throughout the area. Finally, a cure was sought for a serious problem of the now unimpressive heavy traffic of pre-war days, an extremely high accident and fatality rate.

The performance of the Los Angeles freeways toward these objectives is discussed above. It is both frustrating and admirable depending upon whether today's traffic is viewed as what it is or as what it would have been without the freeways.

Critics of the freeway system point out that such of the new facilities as have been completed are filled to capacity with little if any room for traffic expansion. It is admitted that travel speeds attainable are very good, but alleged that with mounting congestion, they cannot get better. The overall safety record of the new system is better than that of the surface streets but the ratio of injury accidents to fatalities is better on the ordinary street system.

On the other hand, twice as many vehicles are registered in Los Angeles County today as in 1947 when freeway building began in earnest. Many of the major traffic streets which were hopelessly

overcrowded at that time are now carrying less traffic than they have since 1939. Except for two peak periods of the day, average speeds of nearly fifty miles an hour are possible over a stretch of approximately thirty miles of freeway which leads right through the heart of Los Angeles.

Finally, the injury accident rate for the freeways is less than half that of the surface streets, and the fatality rates for both are less than half what they were in any year preceding 1947.

Thus, to see the real improvement caused by the freeway, the long view is necessary. Indications are that expansion of the system to the extent contemplated for 1980 will, at long last, fully achieve the goals of capacity, speed, and safety for which the early planners hoped.

Demands and the Fare Structures In the Transit Industry

CARL STERN

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SEVERAL knotty problems beset city planning authorities relative to the use or lack of use of the central business district. Among these, the traffic and parking problem and the crisis of the transit industry are foremost. They are complementary problems. Were traffic congestion eased, urban transit operation would be speeded. This in turn would make urban transit more attractive to the potential user, and more profitable to transit companies.

As transit revenues improved, transit costs would grow less, because faster service would mean greater vehicle availability. Louis Wolfson, former chairman of the board of Capital Transit, estimated he could save more than a million dollars a year were he able to increase the average speed of Washington transit vehicles by even one mile an hour.[1]

The reverse is equally true. The increasing traffic jam in the central business district has served to slow transit vehicles so that annoyed riders have turned to private cars as a substitute. This increases the traffic jam, at the same time magnifying the plight of the transit companies.

Unquestionably, for some cities abandonment of public transportation offers the only solution. Between January 1, 1954 and

1. Quoted in *U. S. News and World Report*, August 26, 1955, p. 37.

Research for this study was financed in part by a grant from Randolph-Macon Woman's College through their program of summer fellowships for faculty study.

September 1, 1959, 119 transit companies ceased operation; some forty-nine of these have since been taken over by other companies or the municipal government.[2] The rest have been abandoned. Their former riders have been left to shift for themselves.

ACCELERATED ABANDONMENT

What has caused this accelerated rate of abandonment in the past few years? In part, it has been factors already mentioned, increased costs, resistance to higher fares, general traffic congestion and its deleterious effect on transit speed. Possibly, too, another factor concerns the so-called expenditures curve for transit, the curve that relates demand to changes in income.

A cynic has said: "There is nothing wrong with the transit industry that a good depression wouldn't cure."[3] The implication here is that the demand for transit is the demand for an *inferior* good. While transit may not fall in the class of the traditional inferior good, such as bread for which consumption declines as income increases, and vice versa, still there does seem to be some analogy. Urban transit companies in their present distress are, to an extent, the victims of too much prosperity.

Many former riders purchased private automobiles, and the patronage of these car owners for the present, and probably permanently, is lost to the transit companies. In the years since 1950, transit operating revenues, measured in constant dollars of 1954 purchasing power, have constantly declined. Gross national product for the same period, and also in constant dollars with 1954 as the base, has increased in all save two of the years.

For the years 1926 to 1959—roughly the period in which there has been automotive competition for the urban transit industry—the year-by-year statistics for gross national product in constant dollars and for transit operating revenues in constant dollars have moved in the same direction in twenty instances and in opposite directions in thirteen. In twelve of the latter thirteen cases, when gross national product increased from one year to the next, the operating revenues of the transit industry declined.

2. Statistics from the American Transit Association.

3. Lloyd F. Howard, "Public Transit Up and Down with the Times," *American City*, July, 1958, p. 34.

In only one instance was the reverse true; that is, in only one case did transit operating revenues rise while GNP was falling, and in this case the decline in GNP was 0.1 percent and the increase in transit operating revenues was barely 1.0 percent.[4]

Thus, if the demand for urban transit is assumed to be the demand for an *inferior* good, the inferiority is apparently present only on the rising side of the cycle. In the other ten instances in which GNP declined from one year to the next, transit operating revenues also declined.

If the experience of recent years carries forward, this reasoning portends a rather gloomy future for the urban transit industry. In recent years, with GNP increasing, transit operations, measured in terms of operating revenues, appear to be inferior, and the expenditures curve for transit declines. When GNP is falling, transit revenues also seem prone to fall. This last is explained by the failure of the transit industry to lure back the patronage of the automobile owners when times get hard. Competent transit officials declare the automobile would be virtually the last of the consumer-durables the citizen would forego in financial stress, and they do not look for relief from this direction.

KINK IN THE DEMAND CURVE

In addition to the constant decline of the expenditures curve, the transit industry recently has been plagued by what appears to be a kink in the *demand* curve. To the distress of the companies, this makes considerable difficulty in the pricing process. The kink is such that, holding income constant, demand over time proves elastic at higher fares (i.e. more people use automobiles, car-pools, or other alternate methods of transportation), while at lower fares, demand seems to turn inelastic.

When fares are reduced, too few new patrons are attracted. Thus the effect of reductions in generating new traffic is insufficient to improve operating revenues. A recent example of this is the much-discussed Operation Northwest in Philadelphia. In this case fares were reduced substantially and, as a result, the volume of traffic increased. For one of the participating carriers, the Reading Railroad, the increase in passengers utilizing the service ranged from

4. See Table I.

6.6 percent in November, 1958, to as high as 18.2 percent in April of 1959.

TABLE I

GROSS NATIONAL PRODUCT IN CONSTANT DOLLARS AND TRANSIT OPERATING REVENUES IN CURRENT AND CONSTANT DOLLARS—1926-59

Year	*Gross National Product-Billions of 1954 Dollars**	*Percent Change*	*Transit Operating Revenues-Millions of Current Dollars†*	*Transit Operating Revenues-Millions of 1954 Dollars‡*	*Percent Change*
1926	$170.8		$1,057.5	$1,606.3	
1927	170.5	+0.2	1,054.2	1,631.9	+1.6
1928	171.8	+0.8	1,040.1	1,628.8	—0.2
1929	181.8	+5.8	1,052.5	1,648.2	+1.2
1930	164.5	—9.5	963.0	1,548.5	—6.0
1931	153.0	—7.0	842.1	1,487.1	—4.0
1932	130.1	—15.0	696.5	1,369.3	—7.9
1933	126.6	—2.7	642.4	1,333.6	—2.6
1934	138.5	+9.4	674.9	1,354.5	+1.6
1935	152.9	+10.4	681.4	1,332.8	—1.6
1936	173.3	+13.3	727.9	1,409.2	+5.7
1937	183.5	+5.9	733.5	1,371.6	—2.7
1938	175.1	—4.6	700.8	1,334.3	—2.7
1939	189.3	+8.1	720.7	1,393.1	+4.4
1940	205.8	+8.7	737.0	1,412.1	+1.4
1941	238.1	+15.7	800.3	1,460.5	+3.4
1942	266.9	+12.1	1,040.0	1,712.9	+17.3
1943	296.7	+11.2	1,294.0	2,007.0	+17.2
1944	317.9	+7.1	1,362.3	2,080.2	+3.6
1945	314.0	—1.2	1,380.4	2,059.6	—1.0
1946	282.5	—10.0	1,397.1	1,923.8	—6.6
1947	282.3	—0.1	1,390.8	1,671.7	—13.1
1948	293.1	+3.8	1,488.6	1,662.8	—0.5
1949	292.7	—0.1	1,490.9	1,680.2	+1.0
1950	318.1	+8.7	1,452.1	1,622.0	—3.5
1951	341.8	+7.5	1,472.7	1,522.8	—6.1
1952	353.5	+3.4	1,501.3	1,517.8	—0.3
1953	369.0	+4.4	1,513.1	1,517.6	—0.0
1954	363.1	—1.6	1,471.8	1,471.8	—3.0
1955	392.7	+8.2	1,426.4	1,429.3	—2.9
1956	400.9	+2.1	1,416.1	1,399.1	—2.1
1957	408.3	+1.8	1,385.6	1,323.2	—5.4
1958	399.0	—2.3	1,349.5	1,255.0	—5.2
1959	426.0	+6.8	1,357.0*	1,251.2*	—0.3

*preliminary estimate

* Department of Commerce.

† American Transit Association, "Trend and Distribution of Transit Operating Revenue in the United States by Types of Service—1926-1958 Inclusive," N. Y., American Transit Association, 1959.

‡ American Transit Association, *op. cit.*, with adjustments based on Department of Commerce statistics of the consumer price index adjusted to a 1954 base.

For the six-month period, November to April, revenues were down by something in excess of $50,000. The carrier however hopes the revenue situation may be on the verge of improvement. In July, 1959, for the first time, revenues at the new and reduced rates were higher than they had been in the comparable month in 1958.[5] While the kink in the demand curve seems to hold true for most transit companies, there are exceptions to the rule. The Metropolitan Transit Authority in Boston took over the defunct Highland Branch of the Boston and Albany Railroad which had for years connected Boston with its western suburbs of Brookline and the Newtons. The authority rebuilt the branch for rapid transit operations.

Service was restored in July of 1959, and on the first weekday of operations the line handled approximately twenty times the number of passengers that the Boston and Albany had handled on a daily basis at the time of the rail service abandonment approximately a year earlier.[6] So successful was it, in fact, that consideration is now being given to the starting of rapid transit operations on the Boston-Braintree portion of the New Haven's ill-starred Old Colony line.[7]

But latter day successes are few. The success of the Boston experiment was dependent on heavy traffic potential and a relatively low fare. Most other cities lack the traffic potential to warrant the investment in rapid transit facilities, and thus they must make do with an existing bus company that has, in most cases, been plagued with declining revenues for the last ten years.

While the causes of the present transit crisis are relatively clear, the solutions are not equally apparent. Obviously there is no one panacea. Instead there are a number of avenues open for experimentation.

HIGH SPEED TRANSIT

First, transit services must be made so attractive and flexible that the door-to-door advantage of the automobile is to some extent mitigated. This involves the operation of high-speed vehicles capable of fast acceleration. At the recent congressional hearings on a master transit plan for the Washington, D. C. area, a number of

5. "Riders Up, So are RR's Losses," *Railway Age*, September 14, 1959, p. 56.
6. *Passenger Transport*, July 24, 1959, p. 1.
7. *Railway Review*, September, 1959, p. 6.

witnesses were seriously concerned by the franchise requirement that D. C. Transit abandon all street car operations by 1963.

Among this group, many felt the PCC cars operated by D. C. Transit could be incorporated into a high-speed rapid transit system. Instead, these cars are in process of being sold or scrapped. Among the former were some cars purchased for use in Yugoslavia. These cars were sold for $4,000 apiece,[8] virtually an upset price. Were the transit study group in Washington to recommend the installation of a rail system, comparable new cars would cost in excess of $40,000 each.[9]

Witnesses cited many disadvantages to the bus operations of D. C. Transit. The buses crowd the streets more than did the rail cars in that their carrying capacity is little over half that of the cars they replaced. Also there was objection to the fumes from the exhaust of the diesel buses. These are particularly noxious in the rush hours when speed is slow and bus traffic density is high.

In most cities, the street car is a dead issue, and its demise resulted from its own lack of flexibility. The renewed interest evidenced in the Washington hearings is mostly in high-speed street car service offered primarily in subway service or in the median strip of expressways.

Where street cars have been abandoned, bus routes have frequently been substituted with a single bus route replacing two or more of the car lines. In order to accomplish this, a number of highly circuitous routes have been established, and this has tended to slow the bus service unduly. If transit service is going to attract new patronage through increased speed, these roundabout routes will have to be replaced with a more direct service. In addition, study will have to be given to the location of bus stops in line with the demands of traffic, and little-used stops abandoned, especially where they are in close proximity to other, better patronized stops.

Express services should be instituted, particularly in the rush hours. If these services are fast enough, a premium fare can be charged. The very speed of these operations may reduce the peak

8. *Transportation Plan for the National Capital Region; Hearings* before the Joint Committee on Washington Metropolitan Problems; Congress of the United States, Eighty-sixth Congress, First Session on Report of the Washington Mass Transportation Survey, November 9, 10, 11, 12, 13, and 14, 1959. Washington, D. C., U. S. Government Printing Office, 1960, p. 903.

9. *Ibid*, p. 621.

demand for additional equipment and thus reduce service costs. The faster a bus reaches its destination, the sooner it is available for other services.

Another factor in speed of operations is the fare collection system. This is materially slowed where pennies are involved and materially speeded where outside men are stationed at heavily patronized stops to permit loading at both doors of the vehicle.

While a weekly pass system also tends to speed the fare collection process, many companies have found that this advantage is outweighed by the lost revenue which can be traced to the traditional interchangeability of the passes. If the use of passes could be carefully restricted to the original purchaser, their use would be looked on with greater favor by the transit companies.

PROPOSALS TO RELIEVE CONGESTION

The second approach to the improvement of the transit situation involves the reduction of traffic congestion in the central business districts of the cities served by urban transit companies. Many proposals have been put forward for solving this problem. Some cities, for example Atlanta, Baltimore, Birmingham, Dallas, Cincinnati, Chicago, and Nashville, have reserved certain lanes on major thoroughfares for the exclusive use of transit vehicles.

Usually this arrangement is in effect during the rush hours only and is supplemented by the placing of restrictions on turns which would cut across these exclusive bus lanes. When this arrangement was put into effect in Atlanta, buses were speeded by as much as 33 percent during the rush hours and automobile traffic by as much as 110 percent.[10]

Some cities of late have established a plan of banning all vehicles from an area in the center of the city and setting up a pedestrian mall. There are varying reports on the success of such plans, and a number of such attempts have been abandoned. A modification of this plan might permit the use of certain central city streets by transit and emergency vehicles only, and this might serve to reduce traffic congestion for the transit vehicles on these special streets and for the private automobile driver on the paralleling streets from which the transit vehicles would then be removed.

Other transit speeding measures relate to parking. In some cities

10. Statistics from *Passenger Transport*, February 14, 1958, p. 1.

fringe parking areas have been set up near outlying transit terminals in an attempt to keep the private cars out of the central business district. Many cities have encouraged this type of arrangement by an absolute ban on parking on downtown streets. Others have merely prohibited it during the peak periods.

Still others have done little to alleviate the jam. In several communities parking was temporarily removed from certain main arteries during one or both of the rush hours. In a number of instances where this was tried, the retail merchants' association was influential in having the ban rescinded because of individual merchant complaints of reduced business. The reasoning of the merchant in this case is valid only in the short run, for, if present traffic jams continue unabated in some of these cities, the impetus for the building of suburban shopping centers will be heightened. Such a development will harm the downtown merchant much more fundamentally than would a rush hour parking ban.

Some communities have set up municipal parking lots in or near the central business district. Such lots may create subsidiary new problems at the same time they solve others. While some curb parking may be eliminated as a result of the establishment of these lots, they also serve to attract more cars to the center city area, and this makes them of doubtful value in alleviating traffic congestion. In one city, Durham, North Carolina, the meter parking fee in the municipal lot is ten cents an hour while the charge is only five cents an hour for curb parking.

Although the municipal lot in this case permits longer-term parking than do curb meters, still this arrangement runs contrary to the effect that should be desired. If there is to be a rate differential, certainly the person parking at the curb should pay the premium, for it is he who should be discouraged from coming into the central business district in the first place.

THOUGHT FOR FARE STRUCTURES

At the same time attention is turned to making transit service convenient, attractive, flexible, and most of all, speedy, thought should be given to fare structures. In this area there are possibilities for experimentation which might in the end result in a considerably improved revenue picture.

The public has long harbored a misconception about this aspect of the transit problem. It has been widely felt that the transit companies earn their best from the peak hour customer, and therefore he should be charged the least. If the assumption were made that the transit company would need all of its vehicles twenty-four hours each day, such reasoning would be valid.

It is during the rush hours that the vehicles are heavily filled, and with costs for the moment approximately fixed, the heavy traffic volume yields a high revenue with a low per person cost. Too often, fare schedules are constructed on the basis of this reasoning, and as a consequence, and this is particularly true of recent years, a situation has arisen which is unfair both to the companies and to their non-peak hour customers.

This situation manifests itself in the establishment of fare schedules that yield a lower fare to the so-called regular customer. Tokens, if they are sold at a reduced price, are an example of such a fare; so are commuter tickets and weekly passes where they are used. In truth, even the blanket fare so widely used in this country exhibits the same inequitable tendency.

For other public utilities—gas, electricity, telephone, telegraph, etc.—the peak user is normally charged the highest rate, and these companies, with an eye to the improvement of their diversity factors, often grant reductions in rates for certain off-peak use of the service. Not so with transit, though there have been occasional experiments.[11] On the whole the transit companies charge everyone the same fare, but obviously everyone is not equally costly to handle. The peak customer is the most expensive of all, but he is not charged accordingly.

For most transit companies, the peak period constitutes only twenty hours a week—two hours in the morning and two in the afternoon on each of five days. The rest of the time much of the equipment stands idle and yields no revenue. One expert in the field concludes that if the daily load of the Long Island Rail Road,

11. Early in 1960, for a four week period, the transit company in Edmonton, Alberta, reduced its ticket fares from 12½ cents per ride to 7½ cents per ride for service between the hours of 9:30 A.M. and 3:30 P.M. and after 7:00 P.M. on weekdays and all day Sunday. There was a resulting 4.2 percent gain in passengers, but this was offset by a 6.4 percent loss in revenue. At the end of the four weeks, the experiment was abandoned. (*Passenger Transport*, March 25, 1960, p. 3.)

which is in effect little more than a rapid transit system, were spread over a twenty-four hour period, the Long Island would have need for only ten percent of its rolling stock and twenty-five percent of its manpower.[12]

In recent years, this situation has become increasingly more acute. The five-day week and television have dealt the transit industry mortal blows. The former has reduced the number of weekly peak-periods by one-sixth; the latter has drained off much of the evening and weekend trade. The decline in evening and weekend business has been so great in some areas that the transit companies have been forced to eliminate or curtail their service during these hours because such operations have not been returning their out-of-pocket costs.

SOUNDER FOOTING FOR FARE STRUCTURES

A number of principles can be suggested for placing the fare structure on a sounder footing. First, fares should be equitable and at least in theory should bear some relation to the cost of the service. Too often the short distance rider must subsidize the long distance rider, the center-of-town rider must offset the losses from the light traffic transit operations in the far suburbs.[13]

How can fares be related to cost of service? In virtually all cases this would mean the abandonment of the blanket fare presently used. This type of fare has the advantage of being simple to understand and easy to collect, but it has the major disadvantage of being inequitable. Zone fares, for all their complexity, at least afford some consideration to cost of service. So do premium fares for special services. Dallas, for example, charges an extra penny per trip for service on its air-conditioned buses. Other companies charge a premium for express service with some few companies carrying this even farther and charging what is in effect a demand charge, perhaps ten dollars per month, for the users of their express service and then charging a regular fare in addition for each time the service is used.

12. Charles Stonier, "Metropolitan Traffic Crisis," *Traffic Quarterly*, April, 1957, p. 221 n.

13. In some cities, for example Richmond, Virginia, Philadelphia, Pennsylvania, and Jacksonville, Florida, recognition of this fact has resulted in the establishment of bus services which operate only in and around the central business district. A reduced fare is charged.

In theory, the most equitable type of fare would be one based both on the distance and the time of day at which the service was used. While this would be complicated to work out, it might be done with a zone system and an increased charge for those customers using the service during the peak period. One of the state utility commissions recently turned down such a fare plan because the members of the commission felt that it was unfair to charge the higher fare to the so-called "captive" users of the service, those who were compelled to ride during the peak periods. Actually though, little has been done to relate fare structures both to distance and time of day, and many transit officials feel that this would be too complicated to be practical.

While experimentation with new fare structures may be one way to ease the distress of the transit companies, other suggestions have also been put forth. One such proposal has been to stagger working hours so that less of the working force is being transported at any given time.

The United States Government has co-operated with the transit companies serving Washington, D. C. by working out such a system. However, in most cities it would be hard to arrange, and while it has often been considered, little has been done along these lines. Recently, the New York Transit Authority again decided to undertake a study to see if such a plan were feasible.

A few other avenues are open to transit companies that might provide relief from their constantly increasing distress.

Cost reductions should be undertaken where possible. For the most part, transit companies have done this. Two-men operations have almost entirely disappeared.[14] Passenger origin and destination studies have been made so as to eliminate little-used services. Other surveys have been undertaken for the purpose of reducing parallel operations insofar as possible and also for better scheduling of equipment. A few companies have tried to reduce costs by spreading out their service and having a longer headway between buses. One company in North Carolina reduced its service by twenty percent and suffered an immediate fifteen percent loss in traffic.

14. The transit company in New Orleans, Louisiana, still operates street cars, and by local ordinance, street car service must be a two-man operation. In March, 1960, the company applied to convert its Canal Street line to bus service. At the same time application was made to raise fares from seven to ten cents. Considerable opposition has arisen to both proposals. (*Railway Review*, March, 1960, p. 1.)

Where transit services are not being used, they should be withdrawn; but this is far easier to suggest than to accomplish. Too often, local politics enters in and precludes the abandonment of clearly superfluous services. A traffic density of less than five passengers per vehicle mile would seem to warrant extremely close scrutiny and probable abandonment.

What of the company that still cannot make its way, even after costs have been pared as far as possible? For this company, abandonment may be the only solution. As has been pointed out, a number of companies have been abandoned in recent years, and others have used the threat of abandonment as a club to force concessions from reluctant regulatory agencies.

The alternatives to abandonment are not popular. The first of these is some sort of subsidy from the merchants of the town in question. Failing this, there is the possibility of some form of government subsidy, or perhaps a tax relief program. The latter can serve as a real aid in particular cases. Most of the transit companies are not plagued with any considerable federal income tax obligations. There are, however, many other federal taxes—for example, gasoline taxes, bus excise taxes, Social Security taxes, and the like—to which the companies are subject.

There could be some sort of abatement here, though little has been done so far. At a state and local level, this type of aid would be particularly helpful. Some jurisdictions have already granted franchise and other types of licensing relief. More sensible perhaps would be relief from state gasoline taxes. Most city transit vehicles operate wholly, or almost wholly, on city streets; why should they pay for the maintenance of state highways which they seldom or never use?

A third and more controversial alternative is municipal ownership or operation where private capital will not take the risk. Of late, a number of municipalities have turned to this.

Public sentiment is usually opposed to most of these relief measures, though for many citizens governmental subsidy, tax relief, even municipal ownership and operation are considered more desirable than outright abandonment.

At the moment, future prospects for the transit industry are not particularly bright. For many of the companies, the need for im-

proved revenues has become critical. For these companies a bold and comprehensive plan must be worked out and put into effect at once. Failing this, the cities they serve will quickly find themselves without any public transit whatsoever.

Protecting Our Highway Investment

CHARLES H. SELLS

Mr. Sells started in the highway business in 1906 as a rodman on a street construction project in his native city of Yonkers, New York. Following his graduation in 1914 with a degree of B.S. in Civil Engineering, he returned to Westchester County to the employ of the County Engineer. Except for a short period during World War I as highway engineer on a nitrate plant at Muscle Shoals, Mr. Sells continued in the Westchester County Highway System until appointed Deputy County Engineer. In 1925, he opened his own engineering business which still continues with offices in Pleasantville, Rochester and New York City. Appointed County Engineer of Westchester County in 1935 on a part time basis, he also operated his own business until 1938 when, coincidental with the adoption of a new charter, he became the first County Commissioner of Public Works. In 1941, Mr. Sells resigned to accept charge of construction in Irak and Iran under lend-lease agreements involving $21,000,000 worth of docks, roads, storage depots and barges. Following that assignment, he immediately went to South America on airport surveys. In May, 1943, he was appointed Superintendent of Public Works for the State of New York. From 1949 until 1958 he served as a Commissioner of the Port of New York Authority. He still continues the operation of his consulting offices and has had many large assignments in highway, thruway, railroad grade-crossing elimination and other construction projects. Mr. Sells was awarded an honorary Doctor of Engineering degree in 1957. He is a member of the Board of Consultants of the Eno Foundation.

HIGHWAY costs are getting more headline attention today than ever before. The failure of the country to keep its highway construction program in step with other facets of economic development during the last fifty years required the federal government to assume a more positive and contributing role than ever previously.

Adoption of the Federal Aid Highway Act of 1956 created a vast new program of forty thousand miles of interstate highways to which the federal government contributes ninety percent and the states ten percent of the cost. In addition, the pre-existing federal-aid program was continued and expanded on a fifty-fifty basis.

Prior to passage of the 1956 legislation—in order to establish a financial plan to put this program into operation—the states were requested by the United States Bureau of Public Roads to submit

estimates of costs for completing the interstate system. At that time, there was little thought that they might be used later as a basis for computing increased costs of the completed mileage when built. In addition, a very short time was made available for preparation of these estimates, stated by some as being only six weeks. In the absence of required standards, estimators in the various states relied on costs determined by contracts under way, historic feasibility, or even personal judgment.

As to expected costs in urban areas, relatively few states had any experience in development of arterial routes; and only a few highway engineers were familiar with costs of carving a highway through the maze of established facilities in populated areas. In these areas, "guesstimates" had to be accepted.

In the final adoption of the act a clause was included, making the cost of relocating and adjusting utilities a part of the project expense. None of these costs was contemplated at the time of preparing the basic estimates. However, these became, when assembled, the basis of the original financial program and appropriation under which construction of the system was started.

MINIMUM STANDARDS ESTABLISHED

Upon adoption of the Act by Congress and its approval by the President on June 29, 1956, the first requirement to be met was the establishment of minimum standards. In general, these were patterned after the designs used on various toll roads built throughout the country during the previous decade.

If it were possible to gather in one assembly the highway designers of past generations, the rejoicing would be unbounded as they realized that at long last a set of standards had been adopted which provides design for service rather than design for dollars.

Directly attributable to the federal government's substantially increased participation in the nationwide attempt to bring our highway systems to a safe and adequate level by direction of Congress, minimum standards of construction design and processes were developed and made a condition of procedure.

The need for such standards was never disputed by the many highway designers and administrators who had seen results of their previous labors smothered by the increasing hordes of automobiles,

because they had been required to design and build within the limits of an inadequate appropriation, rather than to meet the demands of service to transportation. Good pavements became obsolete and wasted, not because of poor design or poor construction, but because of dangerous alignment, inadequate width, steep grades, or similar defects made necessary by short-sighted budget makers, who failed to realize or recognize the type of service that the highway facility would be required to provide.

From the Colorado Department of Highways, Mark V. Watrous recalls that:

> Standards have been established on the basis of economy that effect very little saving in the initial cost at the time, and result in excessive cost when the demand for improved standards requires reconstruction.

M. L. Shadburn, State Highway Engineer of Georgia states:

> One reason that the highway situation is in its present state is that in the early years of roadbuilding we did not purchase sufficient right-of-way widths to permit the construction of additional lanes to carry increased traffic. This, of course, would have been the cheapest money that could have been spent.

Echoes of these sentiments resound from all sections of the country and it is not surprising that administrators of the revitalized and extensive federal-aid program are united in their efforts to look ahead in their planning so that the highways, when built on the federal-aid and interstate highway systems, will meet the requirements for services expected within the reasonably forseeable future.

A target date has been set at 1975, only fifteen years ahead. By tabulating the reasons for highway inadequacies during the last generation and by relating these to the growth of various types of automotive transportation and of population, a reasonable picture can be developed which will show just what America needs in highways at that time.

In a series of hearings before the subcommittee on roads of the committee on public works of the United States Senate, Bertram D. Tallamy, federal highway administrator, demonstrated to an informed and exacting committee the imperative need of a set of standards against which the merits of any highway design should be and could be valued. At the same time, he injected into this process

of evaluation the leavening that sound engineering judgment would deem justifiable because of the wide variety of climatic conditions, topographic obstacles, population densities and distributions, traffic trends and other design factors prevailing throughout the United States.

In brief, he is permitting the states to build with federal funds highways that conform to the established minimum criteria, with such appropriate expansions within the approved standards as are dictated by the service required and by justifiable modification produced by project variables.

PROGRAM ACHIEVEMENT TO DATE

Armed with Congressional authority, federal and state appropriations, design standards, and the need to proceed, the Bureau of Public Roads and the states—with the help of contractors, consulting engineers, material suppliers, equipment manufacturers and labor—launched the greatest road building program ever recorded in the history of this or any other country.

In three and one-half years, more than 94,000 miles of highway have been built, 3,350 miles of expressways have been constructed, an additional 4,500 miles placed under contract, at a cost of about 13½ billion dollars, and in addition, plans are being prepared and rights-of-way purchased on 18,000 more miles of the interstate system. This is truly a remarkable record, geared to the American way of doing things. It is proof that the American people believe that an adequate highway system is the Fort Knox of our social, economic, commercial and industrial systems, and the bulwark of our ability to defend them.

Typical of the way of life of a free people, criticism developed. The standards of construction were likened to gold plate. The phrase, "increased costs," was injected into discussions. Plans were said to be faulty. Selection of routes for new locations and by-passes was questioned. Charges of fraud and dishonesty appeared. In short, the program ran the complete gamut of public scrutiny and reaction.

As to the need, value and effect of the use of standards of construction, the following opinions are of interest.

F. R. Oliver, Director of Highways in Arkansas, states:

Obviously, highway standards have had to be increased to handle adequately the growing volume and weight of traffic. The only way highway construction costs could be reduced would be by reducing standards and this would be false economy. It is my belief that highway improvements should be designed for traffic regardless of cost trends.

A refreshing reaction of a highway designer comes from G. Bryce Bennett, State Highway Engineer from Idaho:

If you agree that it is doubtful that contract prices can be cut, then any reduction in cost must be made in design features of the facility. In general, I believe this course would be false economy. It is my opinion that among the western states, with which I am familiar, every effort is being made to provide the most economical design and yet provide the needed facility. In other words, just because the federal government is supplying ninety percent of the money, we have not lost sight of the fact that it is *our* money we are spending.

Dwight R. G. Palmer, Highway Commissioner for New Jersey, expresses his thoughts on this subject:

In our opinion, the use of lower design standards would seriously jeopardize the safety and capacity of the entire highway system. This is false economy, as only a small percentage of reduction in total costs is possible by use of lower standards. This reduction in standards in turn reduces the capacity and service of the roads and thus decreases the value of the entire investment in the highway system. It also brings nearer the time another route will have to be constructed in order to handle the traffic demand.

The highway planning division of the Vermont Department of Highways summarizes its opinions:

In following a set of design standards, economies, cost, service and safety must be considered. Which, if any, of these should be sacrificed for expediency in building more miles of highway is a moot question. Rather than build a highway below acceptable standards with resulting accidents, it may be that it is wiser to wait.

In Virginia, J. E. Harwood, Location and Design Engineer for the State Department of Highways, states:

We are of the opinion that compromises that lower the standards of design of the interstate system will result in underdesign. We have been

throttled with this in all of our past highway designs and never seem to catch up to a complete, modern, and adequate facility ten years after the project is constructed.

From the State of Washington, W. A. Bugge, Director of the State Highway Commission, adds the following commentary:

Modern highways cost lots of money and there isn't any question about it—they're going to continue to cost lots of money. The high standards required by modern traffic conditions make it necessary to spend more money per mile of highway than we did several years ago. A set of standards has been established by the U. S. Bureau of Public Roads and the states to guide in the construction of our new highway sections. They are specifically designed to make our highway system serve traffic effectively for years in the future. It is essential that these standards be used as a guide.

Park H. Martin, Secretary of Highways for Pennsylvania, announces as his credo the following:

It has never been my thought that we should start out on any primary, urban, or interstate route with a fixed cost per mile in mind and then build the highway to meet the cost. Instead, I believe that the highway engineering profession should plan and design highways to meet the present and anticipated traffic needs and that we will have to accept the costs which result from good, sound, modern highway planning and construction.

As we study these expressions of opinion from competent and experienced individuals in active, responsible charge of highway design and construction in widely scattered portions of our country, we cannot possibly believe that a set of standards of design are the *Gold Plate* of the program; rather must we accept the contrary belief that they constitute the backbone on which the success or failure of the entire program will depend.

In commenting on the need for an adequate set of construction standards, Pyke Johnson of the Automotive Safety Foundation has stated:

In the history of highway development, there has yet to come a period when road capacity is equal to—let alone beyond—existing traffic requirements. Always the vehicle manufacturers have been ahead of the engineer; and the public in its growing use of the car has been ahead of both of them. High standards is one sure area where we had better be safe than sorry—

because to be sorry may mean the difference between life and death on the highway.

SPECIAL PROBLEMS IN DIFFERING LOCALES

In addition to the standards for design generally applicable on a nation-wide basis, we must realize the need to meet conditions specifically pertinent in differing sections of the nation. For example, the forces at the command of Jack Frost will destroy a road more quickly than any traffic load that can be placed upon it. So, in those states subject to frost, different foundation specifications from those used in warm areas must be followed.

In the high mountainous regions, regard must be given to the problems of snow removal and storage. In our broad valleys, highways must be put out of the reach of floods or protected against them. Also in the forests, in the deserts, in newly developing suburban areas, and in our congested cities, special problems exist; and, as part of acceptable design, they must be adjusted to provide adequate protection for the highway structure which, in turn, is required to carry the traffic whose pattern is similar in its ascending surge through all sections of the country.

To the highway designer, any attempt to meet a "cost per mile" standard is certain to result in wasteful and dangerous facilities. After he has met the requirements in widths, grades and alignment as proposed by acceptable standards for present and future traffic, his design must be tailored to fit additional exposure to the varying local and natural conditions throughout the nation. When this is done, the resultant product will meet all tests for economic design, based on its original construction cost and its ability to endure with moderate maintenance.

In the offices of governmental agencies and also in the offices of the nation's consulting engineers, there is a vast reservoir of engineering talent, honest and experienced, able to produce and supervise highway design and construction at a realistic and economical cost. This engineering judgment and talent must be used, respected, and recognized to insure truly economic results.

URBAN PORTIONS OF SYSTEM STUDIED

There has been considerable discussion regarding the advisability of eliminating or curtailing construction of the urban por-

tions of the interstate system to reduce the overall federal cost. This discussion received considerable attention at the 36th Annual American Municipal Congress held in Denver, November 28th to December 2nd, 1959.

The Hon. Richard J. Daley, Mayor of Chicago, addressed the congress at considerable length on this subject. Quotations from his remarks set forth the need of traffic relief:

The United States Bureau of Public Roads, in the October, 1959 issue of *Public Roads*, reported that forty-six percent of the mileage traveled by motor vehicles in the United States was in the urban areas. A survey in the State of Illinois, completed in 1958, shows that forty-seven percent of the motor vehicle miles traveled was in the state's urban areas. The Chicago metropolitan area has forty-five percent of the state's vehicle registration, of which the city itself has twenty-seven percent.

A survey of the Chicago area shows that of 6.5 million daily vehicle trips that begin in the area, only 160,000—or 2.5 percent—leave the area. More than this, at a cordon line drawn at a thirty-mile radius from the Chicago Loop, it was found that 330,000 vehicles drove over the line. Only 16,000 continued non-stop through the area.

It is predicted by the Bureau of Public Roads that the number of motor vehicles registered will increase from 65 million to 101 million in the next fifteen years. By the year 2000, it is estimated that eighty-five percent of the population will be concentrated in the urban areas.

It is estimated that the cost of accidents saved by drivers using expressways in the Chicago area can be capitalized at about $2.5 million per mile. If the time savings too were capitalized, it is likely that the total capitalized savings would amount to from eight million to fifteen million dollars per mile. These statements are not theories, they are not guesses: they represent real conditions and actual trends in the urban areas of the nation.

OFFICIALS EMPHASIZE URBAN NEEDS

At the same congress, A. E. Johnson, Executive Secretary of the American Association of State Highway Officials, stated:

Under current plans, eleven percent of the mileage of the system will be in urban areas, and forty-two percent of the money will be spent in those areas. Approximately half of the motor travel in the United States is in urban areas, so it follows that about half of all the highway income emanates from urban areas. If the big interstate program is to serve needs, then the urban portion must remain as a very important part of the program.

We have also heard the term, "90-itis," bandied about. The connotation placed on this alleges that the highway official has succumbed to a hysteria of gold-plating and over-designing the interstate system, particularly the urban sections, just because ninety percent of the construction is from the federal till. Nothing is farther from the truth, and nothing is so pitifully inadequate as yesterday's alleged over-designed facilities, faced with the realities of today's traffic requirements.

The importance and need for traffic relief in the urban areas was further emphasized at the same congress by Mayor Ben West of Nashville, Tennessee, who is a former president of the American Municipal Association and Chairman of the National Committee on Urban Transportation. He said: "The urban transportation problem is no longer local in scope. Its limits embrace not only the economic and social welfare of our cities, but the national welfare as well."

In spite of the extent and logic of these typical statements, discussions still continue on the basis of reducing the overall cost of the interstate system by avoiding urban areas. To reduce such discussions to an absurd degree, let us imagine that any obstacle that costs a few extra dollars should be avoided and the roads should be built in the cheapest possible locations. Then we should avoid the mountains, keep out of snow and ice, shun the rivers and the valleys where bridges are required, dodge the expense of rights-of-way in cities and suburban areas, duck the swamps and forests, commit no property damage, and spend only a minimum possible number of dollars per mile. And what would we have? An inexpensive system that goes nowhere, solves no traffic problems, and remains a living example of what not to do.

Apropos of this discussion, Major General Louis W. Prentiss, Executive Vice President of the American Road Builders Association, stated: "It should be noted that costs per unit of traffic served is less on multi-lane, divided, controlled access highways than on our light-traffic secondary roads."

HIGHWAY COST-INCREASE ANALYZED

The establishment of a manual of minimum standards, together with the cost of building highways in the urban areas—as reflected in the actual costs of construction during the first three years of the

new federal program—have been challenged as contributing to increased costs of the program. In analyzing this situation to attain a clear conception of the exact intent and meaning of the phrase, *increased costs*, we should determine against what is the alleged increase measured. If the 1956 estimates—prepared as previously explained in this article—are the basis of comparison, then such comparison is valueless, as one can see readily by appreciating the difficulties incurred in preparing the original estimates.

The Congress recognized this by a revision of estimates in 1958 and further by directing the preparation of new and more comprehensive estimates. These are now in progress and are scheduled for presentation to the Congress in 1961. The original estimates presented to the Clay Committee, fathers of the 1956 Act, were based on 37,700 miles of route. Twenty-three hundred miles were later added to bring the total to the 40,000 miles authorized by the Act.

Subsequently, 1,000 miles were added to the system but no federal authorization was provided therefor. With the presentation and approval of the estimates currently underway, a basis will be available not only as a guide for federal fiscal authorization, but also as a possible yardstick to determine the relationship between estimated costs and actual costs as encountered.

There have been, of course, actual increases in cost of highway construction during the last three years and, in all probability, these increases will continue, along with increases in cost of practically everything. Indications at the present time, however, point to the fact that highway construction costs are increasing at a lesser rate than many other activities.

The United States Department of Labor consumer price index shows an increase of 25.5 percent in the cost of living since the 1947-49 period. With this three-year period taken as 100, the October, 1959 index stood at 125.5, an increase of 25.5 percent. The Bureau of Public Roads price index for highway construction based on the 1925-29 period showed an increase to an average of 144 in the 1947-49 period, and to 163.4 in the third quarter of 1959; or with the 1947-49 index reduced to 100, the third quarter period becomes 113, an increase of only thirteen percent.

This thirteen percent compares with the 25.5 percent increase in general living costs at approximately half the rate of increase in

living costs. Also, while the highway index *decreased* 4.2 points from the first to the third quarter of 1959, the consumer price index *increased* from 123.8 in January, 1959 to 125.5 in October, 1959, or 1.7 points.

In New England, *NERBA*, the New England Road Builders Weekly, dated August 29, 1959, quotes highway construction costs as down 2.7 percent in the second quarter of 1959 (decrease of 0.6 percent in the first quarter) which is in marked contrast with 0.6 percent increase in the consumer price index during the same period. The same periodical stated that labor rates increased 1.7 percent in the first quarter of 1959.

These statistics clearly indicate increasing highway construction costs, but with a tendency to level off in the most recent period. The increases are substantially less than in living costs, generally, and show a declining rate of increase while living costs continue in almost the same upward spiral.

At the convention of the Associated General Contractors of America in San Francisco on March 22, 1960, John A. Volpe, newly elected president, directed a question to Mr. Tallamy: "In your opinion, is the public getting a dollar's worth of highway for each dollar that is spent?"

Mr. Tallamy replied: "A major portion of this highway program is composed of excavation and fill. . . . The unit prices we are paying today for that type of work under the federal aid highway program are substantially identical to those I paid when I first got out of school back in 1925. So I say that we are getting a dollar's worth of value for every dollar we spend."

OPTIMISM OVER RISING HIGHWAY COSTS

As to the possibility of a continuing rise in highway construction costs, considerable optimism is expressed by many highway authorities throughout the nation.

John O. Morton, Highway Commissioner of New Hampshire, expressed his views on this subject:

> I do not believe there is any real problem in connection with rising highway costs that the construction industry and highway engineers are not capable of dealing with. With a long range program in view, equipment manufacturers had the courage to take on extensive research and expansion

programs. They have developed larger, more powerful and more efficient types of equipment.

To improve their competition status and still remain in business, the contracting industry has been forced to develop newer and more efficient methods. Highway engineers by the same token are turning out designs to the fullest extent of the potentials afforded by new construction methods and equipment.

H. L. Aitken, Director of the Department of Highways and Traffic of Washington, D. C., states: "The Department had an interesting experience recently which indicates that, even during a period of rising prices, substantial economics in construction of major highway structures can be achieved by application of improved engineering and design techniques and by greater competition among construction contractors." (He refers to savings effected by redesigns in Potomac River Bridges.)

R. R. Bartelsmeyer, Chief Engineer of the Illinois Division of Highways, writes: "The competition of contractors for work and their experience in constructing this type of highway indicates that advances in labor and material costs can be offset to some extent by operational efficiencies and the use of more productive equipment."

J. M. Sprouse, Manager of the Highway Contractors Division of the Associated General Contractors of America, Inc., advises: "It is generally accepted that the use of higher highway standards permits the use of more efficient and economical design methods and modern equipment."

SUGGESTIONS FOR REDUCING COSTS

Many suggestions appear in discussions on this subject as to possible ways of reducing costs. J. Burch McMorran, Superintendent of Public Works of New York State, says: "Without being at all flip, and in all seriousness, the only way it seems to me that money can be saved on the construction of the highway program is to *build it now*."

W. J. Miller, Jr., Deputy Chief Engineer of the Delaware State Highway Department, likewise advises: "The costs will increase as we delay to move forward."

D. C. Greer, State Highway Engineer in Texas, suggests a

temporary waiving of the limited access provisions of the Federal Act in certain locations and under certain conditions in order to save some money on right-of-way costs.

From the Oregon State Highway Department, W. C. Williams suggests that the principal area for study would be a review of such items as interchanges to assure that they are not overdesigned, particularly as they involve minor traffic movements, and a study of the location as it might be increased by right-of-way costs.

William E. Willey, State Highway Engineer of Arizona, outlines the procedure of his department:

> We have put to use every time cost and labor saving device which appears at all feasible. These include photogrammetry in the fields of mapping and highway location; electronic computers in complex bridge problems and earth quantity estimations; training schools for personnel; the tellurometer, a device for electrically measuring distances. We are constantly on the alert for any new technique or device that will cut costs.

From Illinois, in Cook County, Superintendent of Highways William J. Mortimer suggests:

> . . . right-of-way should be acquired in the country areas before these areas are developed.
>
> I should like to call your attention to the impact of an expressway on property values abutting and adjacent to an improvement. Edens Expressway was opened to traffic in 1951. The value of property immediately adjacent to that expressway has increased ten to fifteen times, while property in the same general area has increased but three to four times.

Anthony DiNatale, Commissioner of Public Works from Massachusetts, emphasizes the value of "more extensive use of photogrammetry and electronic computers."

Some states are seriously considering taking advantage of the Act's provisions which permit states to finance construction in advance of allocation by the federal government. These states are weighing the advantages of immediate construction and use of the created facilities as compared to the cost of the interest charges pending reimbursement.

Further, as a result of studies made by competent authorities, it has been stated that the highway construction industry is presently geared to a total production of approximately three times the

presently utilized capacity. This seems to assure a continuation of productive bidding from contractors which, in turn, will guarantee contract costs at such reasonable levels as a highly competitive market will produce.

After contact with responsible highway officials, contracting organizations and allied interests, and after study of the data secured on a nationwide basis, the results of which are outlined here, the author has reached the following conclusions:

The program authorized by the Federal Aid Act of 1956 is necessary for the economic welfare and development of the United States.

The method of financing is equitable, pending the submission to Congress next year of the Highway Cost Allocation Study.

The governmental highway engineering agencies, with such assistance as the private consulting engineers may be called upon to provide, are capable of carrying the program forward in an honest and efficient manner.

The equipment industry already has geared its output to meet the demand with ample and better machines.

The contracting fraternity has ample resiliency to absorb the work as fast as it can be made available.

Costs will rise moderately as time advances but at a substantially lesser rate than the general cost of living.

Minimum standards of construction are a vital requirement of the program.

Construction of routes through and into the urban areas is a "must."

Budgeting agencies must recognize the importance of this program in the overall needs of the nation's complex economy, and provide proportionate funds to carry it forward.

Finally, the author expresses his sincere thanks to the large number of individuals throughout the entire country who so generously responded to his requests for ideas and information. Some are quoted herein and many, while unquoted, have influenced the thoughts expressed.

Chicago's Accident Experience on Arterials and Expressways

IRVING HOCH

Professor Hoch is a member of the faculty of the Department of Agricultural Economics, The University of California (Berkeley). From 1956 to 1959 he was on the staff of the Chicago Area Transportation Study, and was chief of the Economic Analysis Section when this accident study was made. He holds a Ph.D. degree in Economics, and is a member of the American Economic Association, the Econometric Society, the American Statistical Association, and the Regional Science Association.

ONE of the important benefits expected from expressway construction is the reduction of accidents. As part of a study of benefits and costs of expressway construction in the city of Chicago, accident experience on arterial streets was compared to that on expressways. The goals of this comparison were to measure the amount of accident reduction expressways bring about, and to translate this accident reduction into dollar terms.

Dollar estimates obtained here could then be used (given measures of other benefits attributable to expressways) in weighing expressway benefits against costs. In the absence of measures of other expressway benefits (such as time saving), this dollar figure indicates how much of the cost of expressway construction can be justified by accident reduction.

The comparison of arterial and expressway accident experience was carried out using Chicago data for the year 1958; the major results obtained included these items:

1. One hundred thousand vehicles traveling on a mile of expressway will have 389 fewer accidents per year than 100,000 vehicles traveling the same distance on arterial streets. Of these accidents, 290 are property damage accidents, 98 are injuries and one is a fatality.

2. Accident costs for yearly travel on a mile of expressway (with average traffic volumes of 100,000 vehicles per day) are at least $160 thousand lower than costs for the same amount of travel on the arterial system. The capitalized value of this difference is around $2.5 million. This is a minimum figure; a maximum estimate would be around three times this amount. Thus, ac-

cident reduction can be used to justify a good portion of expressway construction cost, which runs around $10 million per mile within the city of Chicago.

3. There is some evidence that accident *rates* increase with traffic volume. Thus, if traffic volume on a street doubles, the number of accidents will more than double. This implies that, in the absence of expressway construction, average accident costs will increase over time.

4. There is strong evidence that accident rates are high near the central part of the city and that they decrease toward the city limits. This, too, may be a reflection of the effect of traffic volume (in particular, the effect of traffic volume divided by street traffic capacity).

5. Street design characteristics are clearly reflected in accident rates. Thus, the average accident rate per 1,000,000 vehicle miles is 14.3 on the arterial street system. The accident rate on the full expressway portion of Congress Expressway is 2.8 per 1,000,000 vehicle miles. Again, Lake Shore Drive, which is an early version of expressway design, has an accident rate of 6.2 on its limited access portions (that is, portions with ramps for interchanges) and a rate of 11.0 on its signalized portion near the central business district.

METHODS USED TO ESTIMATE RATES

This section outlines the procedures employed to estimate accident rates and indicates how those rates were then used in estimating accident costs. These procedures are summarized in diagram form in Figure 1.

Basic accident data sources were city of Chicago Police Department accident records and Chicago Park District accident reports. The Chicago police records were in detailed form, with information available on the location of each accident and whether the accident was a fatality, injury, or property damage accident. The unit of investigation was the accident, with no attempt to break this down further into incidents for individual vehicles; that is, one accident could involve several vehicles. All accident data used were for 1958.

A sample of arterial streets was selected from those covered by city police records. (Arterials can be defined loosely as major, signalized streets.) The sample consisted of a dozen streets, and all accidents along these streets were enumerated. The sample was selected with two ideas in mind. These were, first, to choose streets near proposed expressways, and second, to obtain thorough coverage of the city by using widely spaced streets.

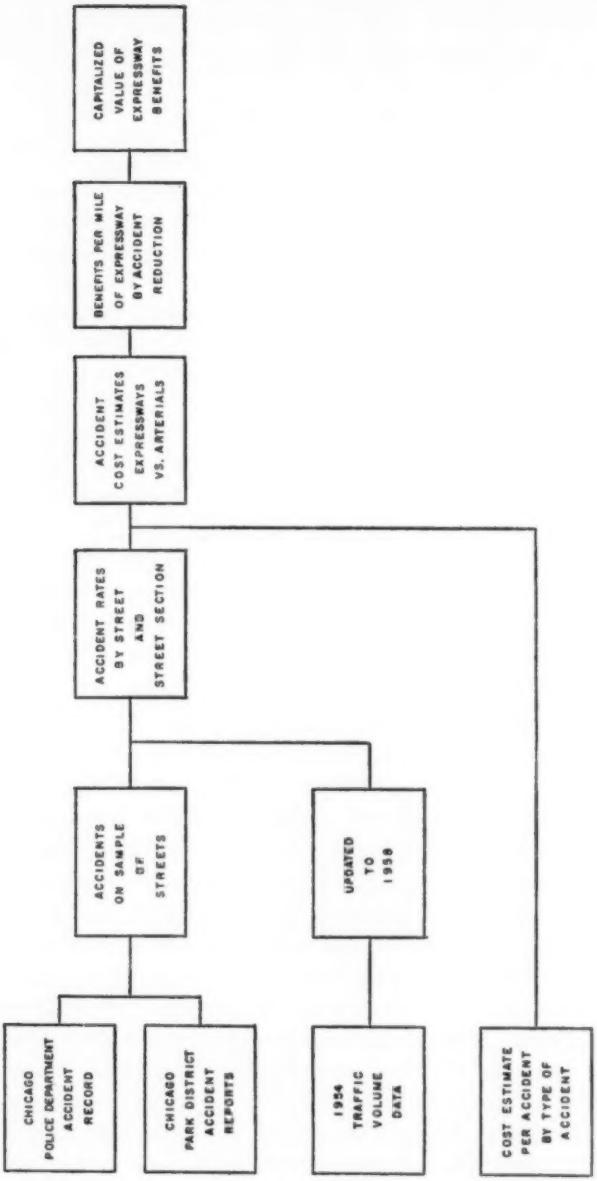
CHICAGO POLICE DEPARTMENT ACCIDENT RECORD
CHICAGO PARK DISTRICT ACCIDENT REPORTS
1954 TRAFFIC VOLUME DATA
COST ESTIMATE PER ACCIDENT BY TYPE OF ACCIDENT
ACCIDENTS ON SAMPLE OF STREETS
UPDATED TO 1958
ACCIDENT RATES BY STREET AND STREET SECTION
ACCIDENT COST ESTIMATES EXPRESSWAYS VS. ARTERIALS
BENEFITS PER MILE OF EXPRESSWAY BY ACCIDENT REDUCTION
CAPITALIZED VALUE OF EXPRESSWAY BENEFITS

Figure 1. Diagram of Procedures in Accident Analysis

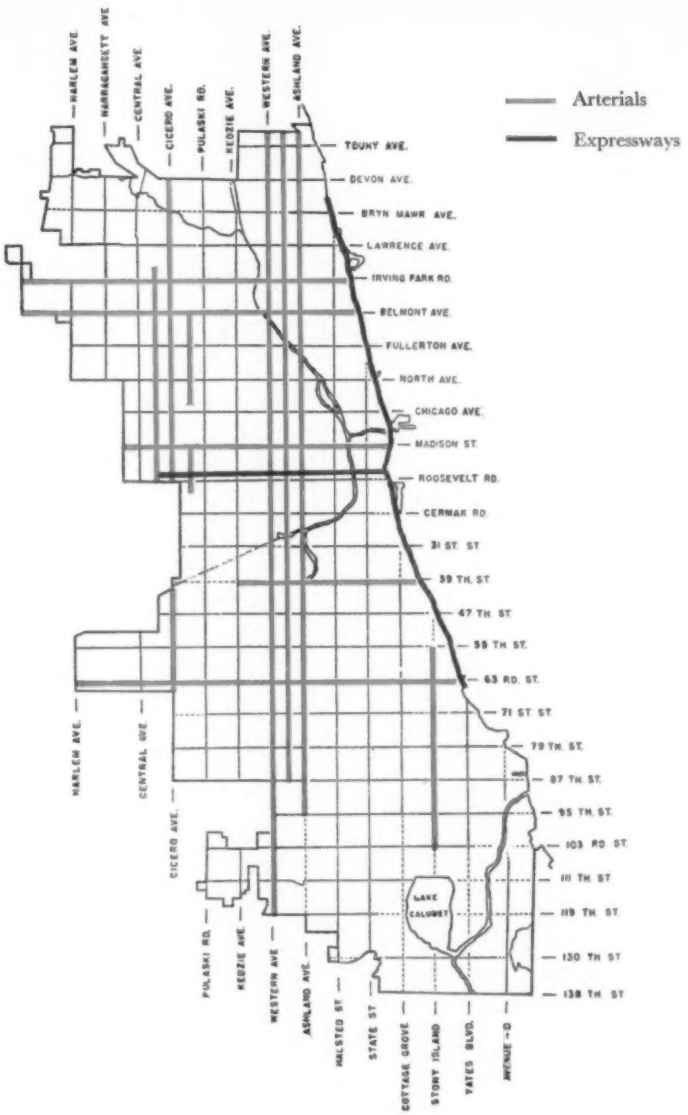

Figure 2. Streets Covered in Sample of Accidents

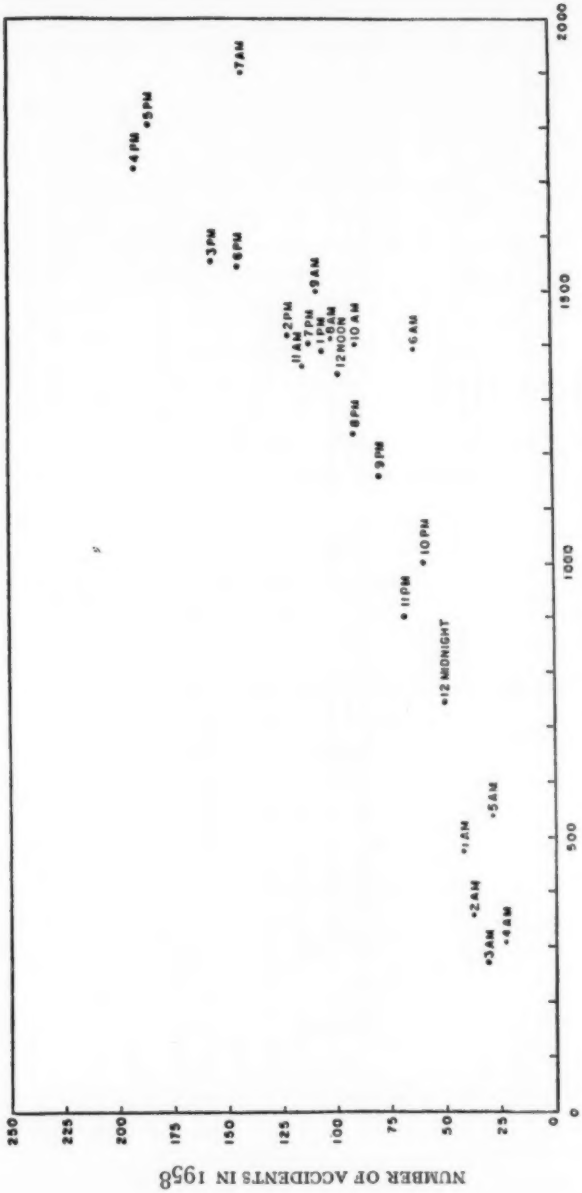

Figure 3. Relating Accidents and Traffic Volume by time of day: Cicero Avenue

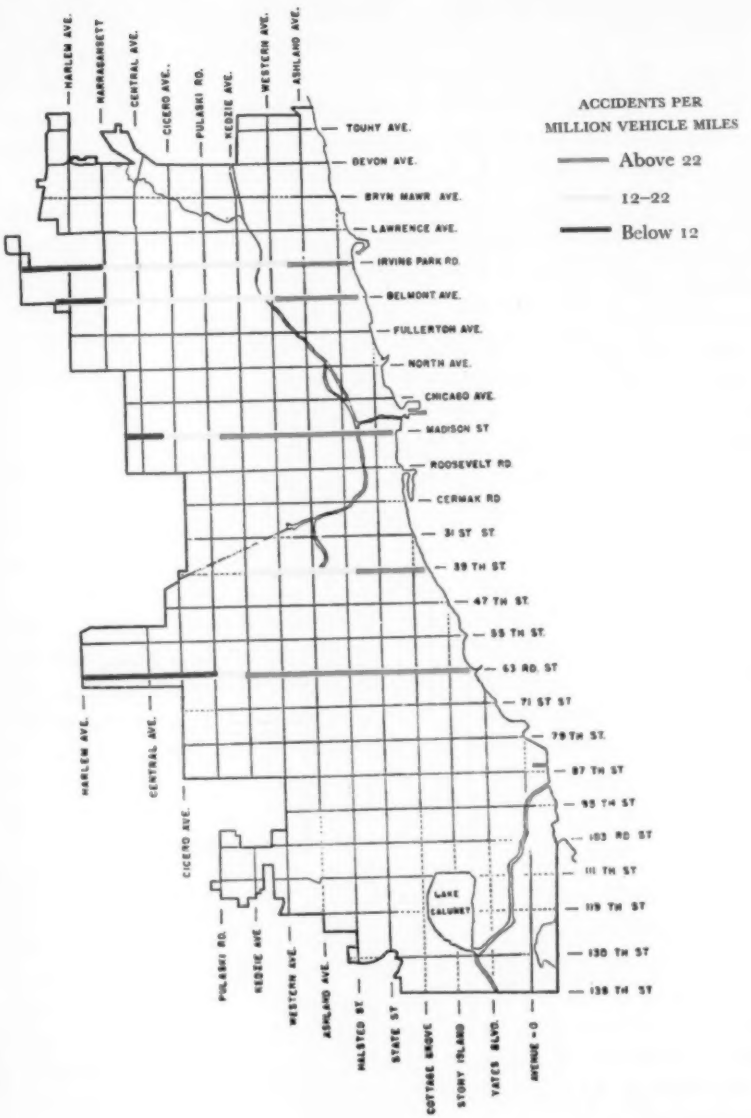

Figure 4. Accident Rates for sample East-West Streets in Chicago

Figure 5. Accident Rates for sample North-South Streets in Chicago

Proposed expressways included north-south cross-town routes near Western Avenue and Cicero Avenue, respectively. Corresponding streets examined were Ashland, Damen, and Western for the first route; and Cicero, Kostner, and Laramie for the second route. Stoney Island Avenue was an additional street selected because of possible location near a future expressway.

An attempt then was made to obtain a representative picture of the city's accident experience by including some widely spaced east-west streets in the sample. These were Irving Park, Belmont, Madison, 39th and 63rd Streets. As a check on these arterial results, average accident rates were calculated for ten major Park District streets and boulevards, treated as a group. (Chicago Park District records in 1958 were not included in city of Chicago police records.)

Detailed accident statistics were then obtained for Congress Expressway and for Lake Shore Drive; these were taken as the expressway figures to compare to arterials, with primary emphasis on Congress since it is the more recently constructed of the two. The locations of the arterials and expressways in the sample are indicated in Figure 2.

Data on traffic volumes for each street were then obtained. The basic source document was a 24-hour traffic map for the city of Chicago prepared by the Illinois Division of Highways.[1] The map showed the number of vehicles that traveled on a particular section of each street on the average weekday in 1954. These readings were updated to 1958 traffic volumes by comparing a number of 1958 traffic counts to the corresponding 1954 figures and adjusting the 1954 figures for a given street on the basis of this comparison.

Given the volume data, vehicle miles of travel were estimated for each section of a given street by multiplying the section length by the number of vehicles traveling on that section during the day. This in turn was multiplied by a factor of 339.5 to obtain yearly vehicle miles traveled on the section. Summing section vehicle miles yielded the street total. The factor of 339.5 was obtained by treating each holiday and week-end day as equivalent to 77 percent of weekday traffic; there were 339.5 weekday equivalents in 1958.

Accident rates were obtained by dividing total accidents on a

1. Bureau of Research and Planning, Illinois Division of Highways, *Traffic Map, Chicago, Illinois*, 24-Hour Traffic Volumes, 1954.

street during 1958 by the total vehicle miles of travel on that street. Accident rates presented here consist of accidents per 1,000,000 vehicle miles of travel. This procedure was carried out for individual sections of each street as well, with the individual sections around a mile or two in length.

ACCIDENT RATE PROCEDURES

The initial accident rates obtained referred to *all* accidents occurring along a given street. However, with a fair number of accidents occurring at street intersections, this involved double counting; that is, an accident occurring at the intersection of streets A and B would be counted as an accident for both street A and street B. The initial rate was termed a "crude" rate, and a "refined" rate was obtained in the following manner:

In counting accidents along an arterial, nonintersection accidents and accidents at intersections with local streets were counted fully, while only half the accidents at arterial intersections were counted. This decision was made because the rate wanted was that occurring on the arterial *system*, which was to be compared to the rate occurring on the expressway system. Detailed consideration of the problem reinforced the conclusion that this was the appropriate measure to be employed.

It turned out that accidents occurring at arterial intersections averaged 36 percent of total accidents for the streets in the sample, with little variation between streets. Half of this figure is 18 percent, so the refined rate could be obtained by reducing the crude rate by this percentage.

DETERMINING ACCIDENT COSTS

An average accident cost for each type of accident—fatal, injury, property damage—had been estimated for accidents in Massachusetts in 1953.[2] It was assumed these average cost figures were applicable to Chicago, and initial cost estimates were obtained under this assumption. (Later consideration of Chicago insurance

2. Dunman, Robie, "Economic Costs of Motor Vehicle Accidents," *Traffic Accident Studies—1958*, Highway Research Board, Bulletin 208. A similar accident cost study is now in process for Illinois (Illinois Motor Vehicle Accident Cost Study, Division of Highways, State of Illinois; Dayton P. Jorgenson, Director).

rates indicated the initial estimate might be low; that is, Massachusetts' accident cost per accident may be lower than Chicago's.)

The 1953 figures were adjusted upward to account for price level changes from 1953 to 1958. The final cost figures obtained were: fatalities, $5,800; injuries, $960; and property damage, $225. It should be noted that these figures refer to *direct costs* of accidents and do not include *indirect cost* components. Direct costs include the value of damage to property, the cost of treatment of injuries, the value of work time lost if the injured person eventually returns to work, legal and court costs, and that part of damage awards and settlements exceeding the sum of the previous items. The most important items of indirect cost are the loss of future earnings from injuries causing death or total disability, and the overhead cost of motor-vehicle accident insurance.

Total accident costs along a street (or a section of a street) were then obtained by multiplying the number of each type of accident by the average cost of that type and summing the amounts obtained. Total costs were then divided by vehicle miles in millions to obtain accident cost per 1,000,000 vehicle miles.

Crude rates were again converted to refined values by multiplying by .82; that is, the crude rate was again reduced by 18 percent.

Given cost per 1,000,000 vehicle miles of travel, costs along a mile of a given street type could then be obtained. Thus, on an expressway, daily volumes are about 100,000 vehicles per mile. This implies that 33,950,000 vehicle miles of travel will occur over a mile of expressway per year (since there are 339.5 weekday equivalents in a year). Multiplying the expressway cost rate per 1,000,000 vehicle miles by 33.95 yields total accident cost occurring on the expressway mile per year.

Total costs on arterials for 33,950,000 vehicle miles was then used as a comparison figure. The difference in costs was found to be $167 thousand, which was interpreted as the gain to drivers if a mile of expressway was substituted for a mile of arterial streets.

The benefit figure derived was the amount obtained per year. A stream of benefits occurring over a period of years can be converted to a present capitalized value using interest tables. (If the stream of benefits occurs perpetually, the conversion can be ob-

tained by dividing by the interest rate.) It was assumed that the stream of benefits would occur for only twenty-five years, this being a conservative assumption. The market interest rate was taken as five percent.

The capitalized value of $167 thousand per year under these assumptions is $2.35 million. This can be taken as (roughly) the value of a mile of expressway in accident reduction.

Some qualifications of this estimate are considered subsequently in this article; these qualifications indicate capitalized value may be as low as $2 million or as high as $7.5 million a mile.

CALCULATION OF ACCIDENT RATES

The sample of arterial accidents made up a fair share of Chicago's total, amounting to 16 percent of total accidents in 1958. Expressway accidents amounted to an additional four percent, so total coverage was 20 percent of Chicago accidents.

TABLE I—COMPARING THE SAMPLE TO OTHER POPULATIONS

	Population				
Type of Accident	*City Police* (1958)*	*Park District† (1958)*	*City of Chicago‡ (1958)*	*Sample (Arterials) (1958)*	*Massachusetts Study§ (1953)*
Fatal	250	44	294	48	315
Injury	24,497	3,681	28,178	4,648	33,270
Property Damage	68,811	10,772	79,583	12,803	97,915
Total	93,558	14,497	108,055	17,499	131,500
	Percentage Breakdown				
Fatal	00.27	00.30	00.27	00.27	00.24
Injury	26.18	25.39	26.08	26.56	25.30
Property Damage	73.55	74.31	73.65	73.17	74.46
Total	100.00	100.00	100.00	100.00	100.00

* *Annual Traffic Accident Summary*, Chicago Police Department, 1958. Report prepared by Patrolman J. J. McCarthy, Statistical Unit, Chicago Police Department.

† From Monthly *Traffic Accident Summary*, Chicago Park District.

‡ City Police plus Park District figures.

§ R. Dunman, "Economic Costs of Motor Vehicle Accidents," *Traffic Accident Studies —1958*, Highway Research Board Bulletin 208, Table I, p. 17. Accident figures are for the State of Massachusetts.

There was good evidence indicating that the sample was representative of the city. Thus, in Table I, accidents are categorized as fatalities, injuries, or property damage. The percentage distribution

of these types is almost exactly the same in both the sample and the city as a whole. It is of some interest that Chicago's percentage distribution is very similar to that occurring in Massachusetts in 1953.

In all cases, fatalities are a very small portion of total accidents (about .3 of one percent); as a consequence, fatalities make up only a small fraction of total accident cost, even though the cost of an individual fatality greatly exceeds that of the other accident types.

TABLE II—SUMMARY OF ACCIDENT DATA BY STREET

Street	*Accidents In 1958*				*Percent of Total Occurring At Arterial Intersections*
	Fatal	*Injury*	*Property Damage*	*Total*	
Total Sample	48	4,648	12,803	17,499	36
Ashland	9	736	2,001	2,746	32
Belmont	3	245	700	948	38
Cicero	6	507	1,716	2,229	38
Damen	3	321	809	1,133	38
Irving Park	4	306	952	1,262	40
Kostner	0	77	278	355	46
Laramie	0	157	545	702	36
Madison	5	391	814	1,210	34
Pershing	1	192	458	651	42
63rd	1	527	1,272	1,800	30
Stony Island	3	243	576	822	28
Western	13	946	2,682	3,641	36
Selected Park District Streets*	16	1,845	4,874	6,735	—
Lake Shore Drive†					
I. Limited Access (Ramps)	5	449	1,571	2,025	—
II. Signalized	2	221	769	992	—
III. Partial Access	0	75	402	477	—
Congress Expressway					
I. Full Expressway	0	162	346	508	—
II. Signalized‡	0	28	87	115	—

* Includes the following streets and boulevards: Augusta, Garfield, Jackson, Jeffrey, Marquette, Michigan, Sacramento, Sheridan, South Parkway, and Washington.

† Location of sections: I. Hollywood to North, Balbo to 47th
II. North to Balbo
III. 47th to 63rd

‡ In Central Business District.

Following the procedures outlined previously, accident rates were obtained for each of the streets in the sample. Table II presents

a summary of accidents by type, and lists the percentage of accidents occurring at arterial intersections. Half this percentage was removed in transforming crude rates to refined rates.

Table III lists crude and refined accident rates per 1,000,000 vehicle miles, obtained by dividing total accidents by vehicle miles of travel (in millions).

TABLE III—ACCIDENT RATES FOR 1958 BY STREET

	Total Accidents	*Total Vehicle Miles in 1958 (Millions)*	*Accident Rate Per Million Vehicle Miles (Crude)*	*Accident Rate Per Million Vehicle Miles (Refined)*
Total Sample	17,499	1,007.5	17.4	14.3
Ashland	2,746	181.3	15.1	12.7
Belmont	948	56.0	16.9	13.7
Cicero	2,229	137.9	16.2	13.1
Damen	1,133	82.7	13.7	11.1
Irving Park	1,262	80.6	15.7	12.6
Kostner	355	18.0	19.7	15.2
Laramie	702	36.0	19.5	16.0
Madison	1,210	42.9	28.2	23.4
Pershing	651	34.1	19.1	15.1
Sixty-Third	1,800	63.8	28.2	24.0
Stony Island	822	64.3	12.8	11.0
Western	3,641	210.0	17.3	14.2
Selected Park District Streets	6,735	416.2	16.2	13.3*
Lake Shore Drive				
I. Limited Access	2,025	325.7	6.2	6.2†
II. Signalized	992	90.0	11.0	11.0†
III. Partial Access	477	51.9	9.2	9.2†
Congress Expressway				
I. Full Expressway	508	182.0	2.8	2.8†
II. Signalized	115	5.7	20.2	20.2†

* Assumed to be .82 of crude rate. † Defined as equal to crude rate for expressways.

In examining Table III, it can be seen that the accident rate on arterials is well above that on expressways. The crude rate for the sample of streets worked with is 17.4, which is more than six times the rate of 2.8 on Congress Expressway.

The accident rate for the sample is quite close to the rate for the Park District streets selected to check the sample. There is some variation in rates between streets in the sample; this may reflect differing degrees of congestion between streets.

Design characteristics definitely appear to affect accident rates. Thus, the signalized portion of Congress Expressway (which goes

through the central business district), has a crude rate about that of arterials. (However, there is some evidence that this rate is below that prevailing on central business district arterials; Madison Street, in the central business district, has an accident rate above 50.) The rates on Lake Shore Drive can be related to design characteristics. Thus, the portion most closely approaching full expressway status (since vehicles enter and leave by ramps) has an accident rate of 6.2. This is somewhat above the Congress Expressway, perhaps reflecting somewhat more advanced design on Congress.

The signalized portion of Lake Shore Drive has an accident rate of 11, almost double the limited access portion. Finally, the far south portion of the Drive has partial access since interchanges occur for some streets at ground level. This portion has a rate in between the signalized and limited access portions, its rate being 9.2.

Examination of accident rates for individual expressway sections of a mile or so in length again indicated a relation between design characteristics and accident rate.

ESTIMATING TOTAL ACCIDENT COST AND COST RATES

Total accident cost could now be estimated by multiplying average cost by number of accidents of each type and summing these subtotals. (As previously indicated, average cost per accident was set at $5,800 for fatalities, $960 for injuries, and $225 for property damage.) As an example, total direct costs for the city of Chicago are presented in Table IV. These are estimated as $47 million for 1958.

TABLE IV—ESTIMATED DIRECT COSTS
OF ALL MOTOR VEHICLE ACCIDENTS FOR CHICAGO, 1958

Accident Type	*Number of Cases*	*Average Direct Cost*	*Total Direct Cost (In 000's Of Dollars)*
Fatal	294	$5,800	$ 1,705
Injury	28,178	960	27,051
Property Damage	79,583	225	17,906
Total	108,055	—	$46,662

It was assumed that average cost figures applied to both expressways and arterials. It might be argued that the average cost of

expressway accidents would exceed that of arterials because of higher speeds on expressways. On the other hand, there will be no right-angle accidents on expressways per se, and it seems likely that right-angle accidents are above the average in costs; a large percentage of expressway accidents occurs on ramps—with speeds equal to or below that on arterials. (The percentage on Congress Expressway was twenty-seven.) Hence, the effects of higher speeds may be balanced out; in the absence of additional information, this appeared to justify the assumption of equal costs.

Total accident-cost figures, when divided by vehicle miles of travel, yielded a cost rate that could be compared between streets and expressways. Table V presents cost and cost-rate figures for the set of streets of this study. For the sampled arterials, the average refined cost rate was $6,202 per 1,000,000 vehicle miles; this is almost five times the cost rate of $1,282 on Congress Expressway.

TABLE V—TOTAL COST AND COST RATE BY STREET

Street	*Total Direct Cost (In 000's Of Dollars)*	*Cost Per Million Vehicle Miles (crude rate)*	*Cost Per Million Vehicle Miles (refined rate)*
Total Sample	$ 7,621	$ 7,564	$ 6,202
Ashland	1,209	6,669	5,602
Belmont	410	7,326	5,934
Cicero	908	6,581	5,331
Damen	508	6,135	4,969
Irving Park	531	6,589	5,271
Kostner	136	7,590	5,844
Laramie	273	7,589	6,223
Madison	587	13,708	11,377
Pershing	293	8,602	6,796
63rd	798	12,507	10,631
Stony Island	380	5,916	5,088
Western	1,587	7,558	6,198
Selected Park District Streets	2,961	7,114	5,833
Lake Shore Drive			
I. Limited Access	814	2,498	2,498
II. Signalized	397	4,408	4,408
III. Partial Access	162	3,128	3,128
Congress Expressway			
I. Full Expressway	233	1,282	1,282
II. Signalized	46	8,164	8,164

After accident rates per 1,000,000 vehicle miles of travel were obtained, accident experience for 33,950,000 vehicle miles was then computed. This figure equals the amount of travel occurring on a

mile of expressway during one year, assuming a daily volume of 100,000 vehicles per mile. Accident experience for the equivalent amount of travel on the arterial system was then used as a comparison. Results are shown in Table VI.

TABLE VI—YEARLY ACCIDENT EXPERIENCE OCCURRING ON A MILE OF EXPRESSWAY VERSUS CORRESPONDING EXPERIENCE ON THE ARTERIAL SYSTEM

	Accident Experience Per 33,950,000 Vehicle Miles of Travel				
	Fatalities	*Injuries*	*Property Damage*	*Total Accidents*	*Cost Per Year*
On Arterial System*	1.3	128.3	354.1	483.7	$210,550
On Expressways†	0.0	30.2	64.5	94.7	43,525
Difference	1.3	98.1	289.6	389.0	$167,025

* Obtained from sample of Chicago arterials.
† Obtained using rates on Congress Expressway.

There are 389 fewer accidents per year for the expressway traffic, and a consequent cost reduction of $167,025. Further, the substitution of three miles of expressway for three miles of arterials saves four lives. (The fatality experience on Congress Expressway in 1958 was probably exceptionally good. Thus, there have been three fatal accidents through the first nine months of 1959, which implies a fatality rate per 33,950,000 vehicle miles of 0.7 instead of 0.0; if 1958 and 1959 figures are averaged, the fatality differential between expressways and arterials drops to 1.0 in Table VI; that is, a mile of expressway saves one life in this revised version.)

If a market interest rate of five percent is assumed, and the life of an expressway is set at twenty-five years, an estimate can be made of the present value of the yearly accident reduction.

An asset with a life span of twenty-five years should return 7.1 percent as its gross rate of return, given a market interest rate of five percent. (Of the 7.1 percent, five percent is interest and 2.1 percent is a depreciation charge, which will compound to the original value of the asset in twenty-five years.) By treating the value of the accident-cost reduction as a yearly return equal to 7.1 percent of its capitalized value, a capitalized value of $2,350,000 is obtained. Investment in a mile of expressways is thus estimated to yield nearly $2.5 million worth of accident reduction. (If an express-

way were assumed to be of infinite life, the estimated value would be $3.3 million.)

POSSIBLE QUALIFICATIONS OF RESULTS

The results presented on cost reduction are subject to a number of qualifications. Two of the qualifications reduce the estimated benefits somewhat; the remaining qualifications imply greatly increased benefits, probably more than compensating for the reduction. Hence, the figure of $2.5 million in accident reduction benefits appears to be conservative.

Negative Qualification 1: Adverse Travel. With the introduction of an expressway, motorists will tend to go out of their way to use the expressway. With this additional (adverse) travel on arterials, accident exposure will increase. Put more exactly, a mile of arterial driving is replaced by a mile of expressway driving *plus* some additional driving on arterials. On the basis of available evidence, there appears to be an extra tenth of a mile of arterial driving for each mile of expressway driving.[3]

Using the data in Table VI implies an additional $21,000 cost per year per expressway mile; this leaves a net saving of $146,000 per mile per year, which capitalizes to $2.05 million.

Negative Qualification 2: Increases in Trip Length. The introduction of an expressway may also change travel origins and destinations, with a further increase in travel implied. This would increase vehicle-accident potential and would further reduce benefits attributable to accident reduction. However, there is good reason to argue that this does *not* imply a reduction in total benefits. If people change their locational pattern, this can be interpreted as their giving up some of the original benefits of the expressway for new benefits worth at least as much to them as the benefits foregone; otherwise, why change locations?

Putting this in concrete terms: if there is a movement of people

3. This figure is based on experimental results obtained by R. L. Creighton, Chicago Area Transportation Study. Using an abstract model of the street system, it was found that in traveling a mile of airline distance, average over-the-road distance using arterials was 1.23 miles, while the same trip using expressways would be 1.34 miles in length. This implies a ten percent increase in travel for expressway drivers, with no change in origin and destination. Such an increase in travel is justified by the increased speed made possible by expressways.

to the suburbs, given a new expressway, then those moving are willing to give up some time savings (and accident savings) to implement their preferences for suburban living; their behavior indicates that the benefits obtained from the new locational pattern outweigh the benefits they give up. Therefore, it seems dubious to argue that total benefits are reduced, and the negative qualification loses much of its force.

Positive Qualification 1: Reduction in Accidents on Arterials. If accidents increase more than proportionately with volume, then the reduction in volumes on arterials, given a new expressway, will yield a greater accident reduction than that estimated here. In the present analysis it has been assumed implicitly that accident rates are constant, so that if, for example, vehicle miles are cut in half, then accidents will be cut in half. However, there is some evidence[4] that accident rates increase with volume; hence, the reduction of vehicle miles of travel on arterials could yield a more than proportionate reduction in accidents.

Thus, say an arterial had a daily volume of 20,000 vehicles and a yearly accident total of 1,000; if its volume were cut in half (to 10,000), then its accident total might drop to something under 500 —the amount under 500 was not allowed for in the approach used here.

Positive Qualification 2: Indirect Cost Reduction. Cost figures to this point have referred to direct costs. Some estimates of the magnitude of indirect costs were obtained from National Safety Council data.[5]

Comparing the Council's total cost figures with direct cost figures indicated that (1) injury and fatality costs should be increased by 60 percent to account for permanent loss or reduction in wages; (2) having made this increase, insurance overhead implies an additional 58 percent in costs.

If these estimates are accepted (and if it is assumed that insurance overhead would reflect decreased costs), then costs to 100,000 vehicles on a mile of expressway become $95,310 per year; costs to a corresponding number of vehicles on arterials become $452,180 per year. This is a difference of $356,870 per year; if adverse travel

4. Some of the evidence appears subsequently. Additional evidence appears in May, Adolf O., Jr., *A Friction Concept of Traffic Flow*, Michigan State University, 1958, Figure 12.

5. National Safety Council, *Accident Facts*, 1959 edition, pp. 13 and 40.

is allowed for, the difference drops to $311,660 per year. The capitalized value of this figure is $4.2 million.

It should be noted that a number of difficult problems are involved in evaluating the "cost" of a fatality or permanent disability. The value of a person's life may be incalculable—or may best be treated as equivalent to what insurance companies are forced to pay for it. However, some additional speculation on the problem gives some grounds for including wage loss as a cost item. Thus, one might treat a person's income-producing ability as "human capital" which the person owns, a distinction being made between a person as owner and as income producer. This is not so farfetched; for example, a person could choose between investing in machinery or investing in an education. The death of the owner destroys the human capital as well. The loss here is the present value of future income.

A contrary view would be to treat the cost to society as the difference between the person's income and his consumption. Indirect cost becomes the difference between the person's savings at the time of his accidental death and the present value of his savings if he had died a natural death. Perhaps the distinction between these views depends on whether *society* is defined to include or exclude the person who has been killed. The author leans toward inclusion.

Positive Qualification 3: The Effect of Unreported Accidents. Figures developed so far refer to the costs of reported accidents. Thus, there is a question of unreported accidents. Though most of these will be minor property damage cases, the cumulative effect could be substantial. Some evidence on this is afforded by an accident study conducted in New Mexico. R. S. Wiley reports:

> If we had confined our sample to those passenger cars known to have been in accidents within the state, the study would have shown that the direct costs of in-state traffic accidents totaled $4,095,512. However, by including those vehicles which supposedly had had no accidents, or only minor ones costing less than $25, we find that the actual direct costs of in-state accidents amounted to $10,757,420. Thus, more than $6,660,000 in costs was uncovered by the examination of the supposedly accident-free cars."[6]

6. Wiley, R. S., Planning Director, New Mexico State Highway Department, *The Direct Costs of Highway Traffic Accidents*, 32nd Annual Highway Engineering Conference, University of Colorado, 1959.

Wiley's figures, if applicable to Chicago, would imply an additional 160 percent of direct cost to be added to original figures. If this is done (assuming there are no indirect costs for this kind of accident), the capitalized value of direct cost savings per mile of expressway increases from $2.05 million to $5.33 million (with adverse travel accounted for). Including the increment attributable to indirect cost reduction yields a final capitalized benefit figure of $7.7 million per expressway mile.

RESULTS CHECKED WITH INSURANCE RATES

A rough check of results can be obtained by comparing average accident costs developed here to insurance rates. In Table V, the refined direct cost per 1,000,000 vehicle miles was listed as $6,202. The average of miles driven per vehicle is about 10,000 miles per year,[7] which implies an expected direct accident cost per vehicle of $62 per year. Insurance overhead is estimated as 66 percent of direct cost, which would imply a total expected insurance payment of $103 per year.

From available data on insurance rates, it would appear that average Chicago premiums amount to roughly $180 per year; this includes liability and collision insurance and excludes comprehensive coverage.

Assuming an average insurance rate of $180 implies that the direct cost rate used here is probably an understatement, since it amounts to only 60 percent of the insurance rate. Part of the difference may be attributable to unreported accidents for which insurance companies nevertheless pay claims. Again, the difference may indicate that the average cost-per-accident figures used here are an understatement for Chicago (perhaps indicating direct costs are understated, indirect costs are overstated).

It is not possible at this point to distinguish between these cases. In any event, this implies an increase in the capitalized return for a mile of expressway from the minimum $2 million to $3.5 million, excluding insurance overhead. Including insurance overhead increases the return to $5.8 million.

It appears likely that there are additional costs not covered by insurance, which would imply an additional increment of cap-

7. Automobile Manufacturers Association, *Automobile Facts and Figures*, 1958 edition, p. 40.

italized return. (The additional noncovered costs include the first $50 of collision costs and direct and indirect costs for which no insurance claim could be made.)

These considerations lend some credence to the estimate of $7.7 million of capitalized return per mile of expressway, previously developed as an upper bound.

INTERPRETATION OF ACCIDENT COST RESULTS

The discussion of the effect of the qualifications is admittedly speculative; a large number of assumptions and much guesswork were necessary. Hence, these figures are subject to a good deal of revision. However, enough evidence has been presented to indicate that $2 million per mile of expressway is a conservative figure. Further, it is possible that an expressway mile yields as much as $7.7 million worth of accident reduction. This serves as an important argument for the construction of expressways.

ACCIDENTS, VOLUME, AND TIME OF DAY

With the accident data in hand, some additional investigation became possible. Thus, an attempt was made to examine the effects of increased volume on accidents. This was done by relating accidents and volume, by time of day, for a street as a whole.

Hourly traffic counts were obtained for several points along a given street and averaged to yield an estimate of volumes on the street for each hour of the day. Total 1958 accidents by hour of day were available for each street sampled; as a consequence, for a given hour, total accidents per year could be related to average volume.

This procedure yielded twenty-four pairs of observations; the points for each street were plotted on a scatter diagram and some inferences were made.

In examining the scatter diagrams relating volume and accidents, there was some evidence that rates increased as volume increased. However, the evidence was not too strong. About half the streets examined appeared to have increasing rates with volume, while the other half appeared to have stable accident rates. Thus, there is some modest evidence that rates increase with volume. Figure 3 plots accidents and volume for one of the streets showing an increasing rate.

For all streets examined, time of day as well as volume appeared to affect accidents. (In some cases, it is difficult to distinguish between these factors. Thus, maximum volumes and highest accident totals occur around 5 P.M.; it is difficult to tell how much of the high accident rate at this time can be ascribed to volume, how much to time of day.)

TABLE VII—ACCIDENT RATES RELATED TO TIME OF DAY

*Time of Day**	*Daily Traffic Volume On Streets Examined*	*Accidents In 1958*	*Accident Rate: Accidents Divided By Daily Volume*
I. 6, 7, 8 A.M.	38,408	1,676	.0436
II. 9 A.M. Through 3 P.M.	73,552	4,919	.0669
III. 4, 5, 6 P.M.	42,488	3,094	.0728
IV. 7 P.M. Through 12 Midnight	42,984	3,223	.0750
V. 1 A.M. Through 5 A.M.	10,171	1,151	.1132

* A listed hour refers to the entire time span of the hour; thus, 9 A.M. through 3 P.M. means 9:00 A.M. through 3:59 P.M.

For the same volumes, morning hours after 6 A.M. had fewer accidents than evening hours. Table VII presents the evidence in more explicit fashion by summing volumes and accidents for the streets examined by grouped hours of the day. The period from 6 A.M. to 9 A.M. had the lowest accident rate; as time of day grows later, accident rates increase, with a maximum reached in the early morning hours of 1 A.M. to 6 A.M. Factors involved may include light conditions, incidence of intoxication, and driver fatigue.[8]

LOCATIONAL ASPECTS OF CHICAGO ACCIDENTS

The accident data were also used to gain some insights into locational aspects of Chicago accidents.

In examining accidents along a street, a fairly definite pattern emerged, with sections toward the center of the city having high accident rates, sections near the city limits having low accident rates. This is illustrated in Figure 4, exhibiting rates on east-west streets, and Figure 5, exhibiting rates on north-south streets.

For east-west streets, as one moves away from the lake toward

8. Similar results appear in *The Federal Role in Highway Safety*, 86th Congress, 1st Session, House Document No. 93, p. 85.

the city limits, accident rates decline from values above 22 to values below 12 accidents per 1,000,000 vehicle miles. The pattern is not quite so clear for north-south streets, but highest rates are obtained in the central section of the city (Cermak Road to Chicago Avenue) with declining rates as the street approaches the city limits.

A number of factors are probably involved in these results. Some hypotheses that can be advanced as explanation include:

1. Higher congestion in the center of the city. There was no discernible relation between accident rates and volumes along a given street; however, the capacity of streets in the center of the city is probably lower than that in outlying areas. Capacity will tend to be lower because of smaller street width, greater parking. Hence, though volumes may be the same, congestion is probably higher in the center of the city.
2. Higher accidental potential for intersections. This is because:
   a. The distance between arterials decreases as one travels toward the central parts of the city.
   b. The average distance between local streets probably decreases as well; in outlying areas there may be sections with no local intersections; for example, sections through golf courses, forest preserves, and so forth.
   c. Traffic volumes on local streets are probably higher in the central portions.
3. Density of population is higher in the central portions; there will be more pedestrian accident exposure as a result.
4. There may be important differences in trip origins and destinations; the central portions probably have many short commercial trips with more cars parked and involved in movement into and out of parking spaces.

These hypotheses are not mutually exclusive; all seem related to congestion as a possible explanation. This affords some additional evidence that accident rates will increase with increasing volumes on a given section of street.

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Traffic Planning for Chicago

WILLIAM R. MARSTON

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TRAFFIC congestion is a relative term describing a condition of traffic only in the degree an individual is aware he is affected. It is also a condition that lingers in the memory when once one is subjected to it.

There is no measure whereby citizens of one area can travel to another and truly evaluate traffic congestion. We receive hundreds of suggestions by well meaning people who have traveled to traffic Utopias and have in a brief visit discovered some operating method that caught their fancy. I am sure that there are as many citizens from other areas who go home from Chicago with the firm resolve to force their home town traffic authorities to install some innovation.

Whether this or that city is using this or that signal system or this or that method of channelization makes little difference in the over-all picture. The usual amount of traffic is delayed a usual amount of time and a usual number of accidents result from this movement. This has caused great concern for many people, and has resulted in millions of words being spoken and printed as we tell each other how to solve this gargantuan problem that has been with us since the Model T and is threatening to get twice as serious in the next twenty-five years.

Countless books and magazine articles have been written in an effort to talk the problem to death. Unfortunately many of these works begin with a profound statement that "transportation must be co-ordinated with city planning" or "mass transit needs to be strengthened." Then we suddenly find the author writing about

the evils of rectilinear streets or some other observation with little bearing on the problem. While all of this has been going on, almost no progress has been made toward the completion of a transportation plan that can be molded to urban growth and around which urban growth can be planned. It would appear that with all of our modern know-how we should be doing a far better job in achieving a unified, cohesive and operable transportation system for our urban areas.

It really doesn't matter whether street patterns are curvilinear or rectilinear, whether we build our city to depend on mass transportation or private transportation, or whether we build industry or residences here or there, provided that, when we get through, all parts are co-ordinated and above all, the transportation system is something that can be developed to serve the people and maintain sufficiently flexible form to grow with urban development and change with the times.

BEQUEATHED ASSETS — AND PROBLEMS

Unfortunately most urban areas grew with too little planning. While great park systems, forest preserves and a marvelous lake front are among our assets in Chicago, all provided by far-thinking men, we also have problems they left with us. We have offset streets creating miserable jogs; there are diagonal streets that meet two other streets to create six-legged intersections; we have streets that are not continuous and vary in right-of-way width, and we have business streets that become residential streets in an adjoining suburb. A most serious situation is the varying types of frontage and the lack of proper building setback requirements. Most cities, including Chicago, are faced with the task of preserving this hodgepodge which can't possibly be thrown away because of the impossible replacement cost. Many have advocated that this be done, however, and are waiting until they can afford to do so. Consequently, many cities have made little or no progress toward reducing stagnation.

Chicago was among the earliest of the cities to come to grips with the cold fact that a city must make use of serviceable things that can be adapted to today's scheme. Most cities, including Chicago, cannot afford to thorw away last year's streets just because

they are not quite in style. We can't throw away anything that can be made to work. It is time, it seems to me, to start thinking realistically in regard to our urban transportation system; time for highway planners to stop trying to build rural highways in cities and start developing urban roadways that are practical and economically feasible.

Chicago does not intend to make radical departures from her rectilinear street system. We shall adjust the alignment of major streets and rebuild them to make them compatible where necessary but they will continue to be the foundation of our traffic plan. Mass transportation will continue to hold a prominent place in moving people between home and work. Expressways are and will be important links in the traffic system. Mass transit in the form of rail service or bus service will be incorporated on expressways where justified.

As the struggle to undo our transportation tangle has progressed through the years we have concluded that major limited access highways are not the cure-all. Even if they were we don't feel that we can afford to sit back and wait for this solution. It is evident to us that regardless of these highways the amount of traffic that must be served by major streets is and will continue to be substantial.

We believe that normal city circulation traffic not served by expressways will demand improvements to our major street system and in providing facilities for this movement we can arrange to handle some of the so-called through-movement with little additional cost. We believe that the service provided by these major streets can be attractive and proper for most urban traffic. With the limited amount of highway money available we hope to improve service for as many vehicle miles as possible in the shortest possible time with as little disruption to the dense urban area as possible. The value of relatively small improvements to surface streets is immediately realized. These major streets will need reconstruction not only to serve the urban traffic load but also to eliminate any depreciating effect they might have on abutting property.

To establish better understanding of Chicago's daily traffic, statistics show that in the city proper 950,000 vehicles, registered in Chicago, and another 350,000 from the suburbs travel 20,000,000 vehicle miles. About 2,000,000 of these miles are on expressways

and about five-and-a-half million of them will be when the initial system of expressways is completed. Fifteen million of the vehicle miles are on the major or preferential streets and 3,000,000 on local residential streets. The total vehicle miles in the metropolitan area is around 35,000,000 daily. At the time of maximum movement there are 325,000 vehicles moving in Chicago's streets. The major street network is, in general, a grid system with major streets at half-mile intervals. The most continuous are the streets spaced at one-mile intervals. Traffic signals are spaced generally at quarter-mile points so a progressive speed of twenty-eight to thirty miles an hour in all directions is possible. Diagonal streets occasionally spoil this progression, and in some of these cases simple low-cost grade separations are in place or under construction to reduce the effect of complicated intersections.

SELF-SUPPORTING

All of Chicago's mass transportation is self supporting and is operated by either privately owned railways in the case of the commuting service, or in the case of the subway and bus system by an Authority. The Chicago Transit Authority carries 1,800,000 passengers daily and the commuter railroads carry 238,000.

Both private and public parking facilities serve Chicago. The city-owned lots and garages are city-wide and are supported by parking meter revenue and revenue from the facilities. There is no actual tax subsidy. One toll highway exists within Chicago. This is the seven and a half mile expressway and bridge connecting the Indiana tollway with the heart of Chicago.

The daytime population of Chicago's central business district is between 800,000 and 1,000,000 persons. About 350,000 of these enter between 7 A.M. and 9 A.M.—eighty percent by mass transportation. City-owned parking facilities in the central business district accommodate 6,700 cars and private facilities another 40,000. The area is the terminus of most of the expressways now under construction and is served by the famous Outer Drive along the Lake front. This was the first such road of expressway characteristics and has been serving as many as 140,000 motorists daily for twenty-five years. A small amount of money will bring it up to modern standards.

In 1950 a report that made recommendations for improving

The Archer-Ashland through-lane-overpass is attractively designed and landscaped.

The single bent construction allows adequate space for surface movements.

traffic movement in the central business district was developed by a special committee appointed by the mayor. This report recommended a system of one way streets, exclusive bus lanes, stricter curb controls and the separation of pedestrians and vehicles. A complete system of east and west one way streets has been effectively operating for several years, a transit lane on one of the Loop streets is giving excellent service and the recommended parking controls are in effect.

The Bureau of Street Traffic grew suddenly to a Bureau in 1950 from an organizational position somewhat lower in the scale. What this lesser status had not provided was compensated for, to a great degree, by Chicago's traffic engineer, Leslie Sorenson. As one of the world's earliest traffic engineers, he developed many of the methods, standards and practices of this profession. The present traffic policies in Chicago and many elsewhere are based on his basic theories. Beginning in 1950 there was an increase in the tools of the profession available to Chicago.

For example, the staff of professional engineers increased from five to thirty. A new $750,000 sign plant capable of 250,000 signs annually was placed in operation. The amount of traffic paint applied each year to our 3,700 miles of streets increased from 2,700 gallons to 47,000 gallons. Concurrent with this change was a new effort in enforcement through traffic police and traffic court reorganization and a stepped-up educational program. Within the last few years all but a tiny fraction of the major streets have been equipped with modern lighting and almost all of the residential sections are relighted. Traffic deaths have dropped from a high of 986 in 1934 to a new low of 300 in 1959. There has been a reduction in deaths each year for the last seven consecutive years. All of this has been achieved without major changes in our street system.

A vast and bold plan for the central business district has been prepared. Steps are under way for the beginning of second level walkways and plans have started on government centers and more high rise buildings along the river and Lake front. The development of a great new section east of Michigan Avenue encompassing more area than is in the present Loop has begun.

This great show of strength by our central area coupled with the entire metropolitan growth provides us with an intensely exciting

field in which to work. Those of us responsible for providing the best and most practical transportation system for this dynamic area have before us a very pleasurable and gratifying career.

While sometime earlier in this article it was mentioned that many cities grew with too little planning it was also mentioned that our legacy includes miles of Lake front park, forest preserves and a great park system. Thanks to dedicated men for their tenaciousness in preserving them and saving them from would-be spoilers.

But still we have uneconomical strip commercial developments, we have badly planned areas and we have incompatible land uses, and above all we have a street system of 3,700 miles that has to be used in so far as possible to provide traffic ways for street traffic today and tomorrow. Many square miles of the city have worn out. The movement outward of residents has left some of the old areas to the lower income groups so that after years of neglect we have slums.

Traffic planning is one of the keys to the redevelopment of the worn-out areas and to the conservation of those that are merely tired. Close co-operation with the department of city planning and urban renewal agencies has resulted in plans that are reasonable and possible of accomplishment. The various urban renewal agencies, through the planning department, are furnished a traffic report as one of the first steps in planning an area. Proposed street widths are given for the streets to remain, traffic volumes are estimated and streets possible of closing are listed. Information about probable future expressways and the effect of these on the area is provided.

Using this as a guide, preliminary plans are developed and then through joint effort a workable design is made ready. Street improvements and changes are scheduled for construction to fit the redevelopment schedule. This may include the complete reconstruction of one street to provide sufficient capacity so another can be closed or it might involve the shift of a street to a new alignment. A number of streets are being reconstructed to designs that will better fit the rebuilt area as well as carry traffic far more efficiently.

A preferential street system made up of a grid network of interconnected trafficways which now carry, or should be improved to carry intercommunity traffic within the city and between Chicago and adjacent communities has been developed. The preferential street system connects neighborhoods in Chicago, provides circula-

tion between neighborhoods, and serves as a basis for development and redevelopment of neighborhoods. The streets making up this grid are primarily the north-south and east-west one-mile and one-half-mile thoroughfares.

Where feasible, the preferential streets connect with state and county routes at the city limits. The network of preferential streets provides a basis for transportation planning and it serves as a guide for agencies that revise, improve, and provide trafficways. This plan was developed by the bureau of street traffic and the Chicago plan commission early in 1950. The alignment of preferential streets is sometimes changed slightly to make them better fit a development. However, in those cases the realignment must provide service as adequate as the original.

We hope to develop the preferential street system to its necessary standards through a series of stages, based on a priority system, as finances and opportunity permit. The stages are:

1. Treatment of intersections by channelization, throat widening, and grade separations as conditions warrant.

2. Provision of proper geometrics for safety and capacity within existing right of way.

3. Acquisition of additional right of way through building setbacks and redevelopment to provide additional capacity where necessary.

4. Construction of new preferential streets of high engineering standards in ultimate right of way.

Wherever possible, the improvements made in the existing right of way will be designed so that they will apply after the ultimate right of way is acquired. About 800 miles of our 3,700 miles of streets are of this category. Traffic volumes vary from about 15,000 vehicles a day up to over 40,000. Roughly 300 miles of the preferential mileage is destined to be developed to major standards with frequent grade separations and in some cases service drives. These streets will have design capacities up to 45,000 vehicles a day. Most of them will be designed for not more than 35,000 vehicles daily.

Much of the preferential street mileage that we intend to develop to the highest standards is already carrying traffic volumes of as much as 35,000 vehicles a day but doing so under considerable pressure. It is estimated that this mileage would not carry materially

less traffic if a greatly enlarged limited access highway system were to become available. It is therefore necessary that these major streets be improved and brought up to a level of performance that will reduce pedestrian-vehicle conflict, increase vehicle speeds, cause the minimum amount of damage to abutting property and provide the best possible service to this property.

As urban renewal programs have gone forward, right of way has been set aside that will permit the major streets to be reconstructed. In areas where all new buildings are proposed we request and get 100 feet of right of way for street sections where no access to the property is needed. In other words, 100 feet will be ample for our purpose provided there are no curb openings except those that will not in anyway interfere with traffic movement and provided no curb interferences will develop. Where such is not the case, sufficient additional right of way is set aside to permit the installation of service drives.

Street sections of substantial length can now be built to the new standards and we are hopeful that a way will soon be open to us to procure right of way in other areas of the city in an orderly fashion that will not create any unnecessary hardships or disrupt city functions.

Most of the preferential street mileage has already been treated in some manner to improve traffic movement. The improvements consist largely of medians and left turn channelizations.Thousands of miles of lane lines are maintained to achieve more orderly flow. A traffic signal plan is in use which limits signal locations primarily to quarter-mile points to provide a good progressive movement in all four directions.

One of the more effective traffic improvements that has been applied to our major streets is the rush hour parking prohibition program. This is one of the lowest cost plans that we have found and results in considerable increases in speed and safety. We have 290 curb miles now so controlled and 160 more are before the city council for approval. Surveys show that an average of only one car for each retail establishment (which might represent a lost customer) is parked during the two hours the prohibition is effective. Many objections result, of course, but no curtailment of the program has been necessary.

Taking an important place in the improvement program is the low cost simple grade separation that provides free moving lanes for some of the movements at a complicated intersection so that the capacity here can be made to match that of the adjacent intersections. Several structures are being designed and one has been completed. The one now in place has exceeded our expectations and has produced a substantial improvement in traffic efficiency at the intersection it serves. When a structure of this magnitude is built it is designed to fit the ultimate design of the street as nearly as possible.

CAN'T WAIT FOR AN ENTIRE-PLAN UTOPIA

One of the major stumbling blocks to the improvement in traffic capacity is the difficulty of solving the problems that occur when a major street passes through a large shopping center. Several plans have been advanced to increase capacity and at the same time improve the shopping center. By applying the principle of the ring road and by-passing through-traffic, we believe we can achieve a reasonable compromise. All centers are now being studied and it is very likely that some concrete action will begin within a very short time at one large center. We feel that this phase of our work is extremely urgent in that we must halt the decline of our shopping centers and help them compete with the attractiveness of the suburban plaza. It is of great importance to our city that the commercial establishments within its limits maintain and strengthen their sales records. Because of this and the needed traffic improvements through the areas, we have placed this work at a very high priority.

Among the paramount aims of Chicago's traffic planning is the preservation and enhancing of the economic, cultural and social values of the entire city. The final over-all plan is necessary, but we cannot wait for the Utopia of the entire plan's coming into being at once. Step by step we must advance toward our final goal and each step brings us closer to fulfillment. We therefore feel that our progress in modernizing the preferential street system is extremely important in the achievement of our ultimate plan.

Efficiency of Movement: Facet of the Metropolitan Problem

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METROPOLITAN St. Louis, struggling with the massive problem of transportation, found the issues, as elsewhere, a welter of conflicting views that puzzled public official and private citizen alike. Debate over the merits and disadvantages of freeways, rail facilities, subsidized mass transit, and the prohibition of passenger cars from the central business district has generated more heat than consensus and action.

Yet, as a 1959 report of the Automotive Safety Foundation observed, "few, if any, of the public issues that our people have been called upon to decide have involved bigger stakes than the issue of urban transportation and how we go about providing it."[1]

This article discusses recent attempts to formulate a comprehensive and integrated solution to the transportation problem in a large metropolitan area. In the realm of hope and speculation rather than of action and accomplishment, the projected plans for transit difficulties in St. Louis embody a far-sighted and imaginative approach that merits careful examination. Although designed for particular needs and characteristics of the St. Louis area, the proposed program relates theoretically to the nation's transportation crisis. The approach, moreover, illustrates current thinking on the need for plans to include all methods of movement and their relation to urban development.

The first major effort to attack the transportation problem in the St. Louis area came in 1954 when a board of freeholders was appointed to draft a plan for a metropolitan transit district encompassing the core city and the suburban county. Handicapped by lack of data and plagued by the controversial issue of public own-

1. *ASF Report*, No. 4, 1959, p. 1.

ership, the Board compromised on a watered-down proposal that voters decisively rejected. The defeat convinced community leaders that a thorough survey of the transportation problem—a systematic fact-gathering program—should necessarily precede political action. Debates over the proposal also convinced leaders that traffic *congestion* and *mass transit* are part and parcel of the same problem.

Discussions of the defeated transit district referendum helped to alert public attention, not only to transportation, but also to other area-wide or regional problems facing the metropolitan community. From this general fermentation of interest, two independently conceived studies emerged: first, a comprehensive transportation survey sponsored by city and county governments; second, a broad-scale investigation by the two local universities—St. Louis and Washington—into the total complex of governmental problems in the area.

Major features of the first study were reviewed in a previous issue of *Traffic Quarterly*.[2] This article will (1) consider the findings and recommendations of that study in the light of the broader survey conducted by the universities, and (2) point out certain relationships between the needs of urban transportation and the total complex of metropolitan problems.

METROPOLITAN ST. LOUIS SURVEY

Early in 1956 St. Louis and Washington Universities received substantial foundation support for a survey of the area's governmental problems. The grant was largely the outgrowth of a citizen movement to obtain some form of governmental restructuring in St. Louis City and County—an area of 554 square miles containing 98 separate municipalities and approximately 1,500,000 people. The movement provoked strong feeling among community leaders that a careful study of area-wide problems should precede any attempt to formulate proposals for submission to the electorate. When the universities were assured of financial backing for such a study, sponsors of the citizen movement agreed to postpone their plans to precipitate the establishment of an official drafting commission.

Known as the Metropolitan St. Louis Survey, the university

2. See R. Gilman Smith, "Co-ordinated Transport Planning for the St. Louis Area," *Traffic Quarterly*, April 1960.

study began in the summer of 1956 and culminated fifteen months later. After a painstaking examination and analysis of major problems confronting the area, the university researchers recommended the creation of a multi-functional metropolitan district for the city and county with jurisdiction in seven functional fields: operation of a metropolitan road system, establishment of a co-ordinated mass transit system, regional planning, economic development, sewage disposal, civil defense, and property assessment. Under the proposal, these powers were to be vested in an elected metropolitan council and an elected chief executive. Existing local governments were to be left undisturbed except for the loss of jurisdiction over those functions transferred to the district agency.[3]

Following completion of the university study, a board of freeholders was appointed by city and county authorities to draft an official proposal for presentation to the electorate. The plan formulated by the board followed closely the recommendations of the survey report.[4] It was submitted to the voters in November, 1959, and decisively rejected by top-heavy margins in both the central city and suburbs.

Opponents capitalized heavily on the argument that the proposal would superimpose another taxing unit of government on the area. Ironically, the plan was caught in a heavy cross-fire from opposite extremes. Suburbanites favoring the retention of the status quo argued that the scheme went much too far; while consolidationists in the central city, including the mayor, maintained that it did not go far enough in integrating existing local governments.

THE TRANSIT STUDY

The university survey, in its analysis of area-wide problems, stressed the serious need for a concerted and large-scale attack on the traffic and transit difficulties of the area. The transportation proposals advanced were limited to the general powers and political framework necessary to cope with the problem as a unified whole. Designing a transportation system to meet the present and future

3. *Path of Progress for Metropolitan St. Louis* (University City, Mo.: Metropolitan St. Louis Survey, 1957).

4. See Henry J. Schmandt, "St. Louis to Vote on Metro Plan," *National Civic Review*, July 1959.

needs of the area within the limits of economic feasibility and technical soundness was the task of the St. Louis Metropolitan Area transportation survey.

The transportation study grew out of community pressure to do something about the mounting vehicular traffic that was choking streets and roads and causing economic losses in some of the more congested sections of the city-county area. The survey enlisted the support of both central city and county government officials. Shortly after the defeat of the metropolitan transit plan of 1954, the mayor of the city of St. Louis and the county supervisor appointed a six-member committee to prepare specifications for a major transportation survey and to supervise its execution.

Funds to finance the work were obtained from the city, county, state highway commissions and the federal bureau of roads.[5] The survey began in September 1956 and was completed in August, 1959, or two months before the election on the freeholders' district plan. While the timing was somewhat unfortunate, since the findings and recommendations of the transit study lent considerable strength to the metropolitan proposal, it is doubtful that earlier dissemination of the results would have materially affected the election returns.

A review of the two studies—the university and the transit—shows fundamental agreement between them on their basic philosophy and underlying assumptions, as well as their general approach to the transportation problem. Both are predicated on the interrelated premises that:

1. piecemeal efforts to solve the major problems of urban areas are doomed to failure;

2. the transportation problem cannot be divorced from the broad objectives of community planning and development, nor from demographic and ecological factors;

3. the transportation problem is one of moving people and goods (rather than vehicles) swiftly, efficiently, and economically;

4. the problem of traffic congestion must be identified with that of mass

5. The survey was conducted by W. C. Gilman and Company as principal consultants, and Wilbur Smith and Associates and Marketers Research Service as associate consultants. Dr. J. Douglas Carroll, Jr., served as technical adviser to the citizens committee. Cost of the study was approximately $525,000.

transit—its solution lies not alone in the building of more roads and highways, but in the greater use of public transportation;

5. operating rights must be accorded mass transportation comparable to those provided the automobile;

6. speed is the major factor in the ability of a public transit system to attract riders;

7. the automobile user must bear a greater share of the cost of providing and maintaining the urban transportation system;

8. whether the transit system is publicly or privately owned, and whether politically palatable or not, some form of governmental subsidy for mass transportation is essential and inevitable;

9. control over the planning, development, and operation of a co-ordinated transportation program must be vested in an area-wide government or public agency that transcends municipal and other local political boundaries and that possesses sufficient power to deal effectively with the total problem of moving goods and people.[6]

OPERATIONAL CHARACTERISTICS OF TRANSIT PLAN

The transit survey's program to give St. Louis an efficient circulatory system possesses many attractive features. Although a number of these have been pointed out in the article previously cited, a brief summation of the plan is given here to indicate how its operational characteristics are designed to achieve the basic objectives of a sound transportation system.

1. 100 percent motorbus use;

2. commingling of rapid transit portions of the system with other traffic on the outer portions of expressways but operation on special rights-of-way in the congested districts;

3. design of surface operations so that no substantially developed area is more than a quarter of a mile from a transit route;

4. encouragement of combination auto-transit travel by establishing free parking lots at outlying locations;

5. penalizing the long-term parker in the central business district;

6. improvement of exisitng road and traffic control facilities to speed up vehicular movement;

7. public ownership of mass transit facilities.

6. The transit study recommended the creation of a transportation agency or authority for the St. Louis city-county area with broad basic powers over traffic and transit. Although the form or organization of such a unit was not discussed, the report indicated that it could properly be an independent agency or a division of a more comprehensive metropolitan setup as recommended by the university survey.

After carefully evaluating alternative solutions, the transit study settled on a motorbus network as the most feasible mode of transport for the area. Major factors that influenced this decision were: low maximum-hour passenger volumes that could be anticipated on the major radial routes with a rapid drop off of these volumes at distances of three to four miles from the downtown core; the existence of an expressway system that would be in direct competition with rapid transit service along most of the indicated vectors of heavy travel; and the disadvantageous location of railroad rights-of-way that might be suitable for rapid transit.

The proposed system is based on the premise that if mass transit is to achieve a competitive position with the private automobile, it cannot use the expressways jointly with general traffic except in outlying locations where all traffic moves freely at the highway design speed. Under the plan, a total of eighty-six net route miles of rapid transit service would be provided, with almost one-half of this mileage on grade separated roadways reserved for bus use exclusively and the other half on the expressway system. The proposal would require construction of approximately forty-two miles of elevated roadway, including a distribution loop in the downtown business district. Five main radial routes would converge on this loop, while a sixth route would run crosstown in the western section of the city. The radial routes would use the outer portion of the expressways but operate on the grade separated roadways for distances of three miles or more as they approach the central business district. The crosstown route would operate entirely on a separated roadway.

The system is so designed that the elevated roadways would not interfere with full use of the present street pattern. Existing alleys would be used to locate the structures over major portions of the routes. Buses would enter the transit structure from the expressways by regular service ramps. They would then travel to the downtown area where they would directly enter the elevated distribution loop. This loop is one of the key features of the plan. Designed to circle an area of thirty square blocks containing virtually all of the downtown department stores and major office buildings, it would bring over seventy-five percent of all persons now entering the central business district to within two blocks of their destination.

A comprehensive program for automobile parking is closely tied into the transit operations. This part of the plan has two facets: one relating to joint transit-auto trips, the other to exclusive auto trips. The first contemplates the establishment of so-called "park-ride" lots adjacent to outlying rapid transit stations where free parking would be provided transit users. The second pertains to parking in the central business district. Practically all available space within the core would be used for short-term parking, while long-term or all-day parking would be located out of the highly concentrated sections of the downtown district where necessary space-day income can be obtained with lower parking rates and low turnover.

Parking rates in the core area would be fixed so that they are reasonable for the short-term parker but penalize the all-day customer. To accommodate the latter, parking decks would be constructed on the perimeter of the central business district and arranged in such a way that automobiles could enter directly from the expressways. Free shuttle bus service would be furnished to the core area.

Trip patterns revealed by the origin and destination survey call attention to a dimension of the transportation problem that has received too little attention. Traffic movement in a metropolitan area is popularly visualized as a simple in-and-out movement between the downtown and the periphery of the area. Frequently overlooked, in the anxiety to preserve the central business district, is the increasing diffusion of industrial and commercial establishments—a development that has created significant lateral movements of traffic and further complicated the transportation web.

The St. Louis study, for example, shows that while the central business district is the major center of concentration, only 11.4 percent of the total person trips and 37.2 percent of the public transit passenger trips originating in the city and the urbanized periphery are downtown oriented. These and similar figures in other areas have important implications for metropolitan planners. Most important of all, they demonstrate the necessity of viewing the transportation system in broader terms than a simple radial pattern focused on the central business district. The St. Louis plan, with its relatively high degree of flexibility, gives general recognition to these developments and their implications for movement.

Urban governments require sufficient revenue to meet current operating costs and to finance large-scale capital improvements. Both services and capital needs must be weighed in relation to the capacity of a community or area to support them. Since this capacity is limited, choices must constantly be made between programs and projects. Large outlays cannot be made in one field to the detriment of other public needs.

FINANCING THE TRANSIT PROGRAM

As in all cases where community or individual values are concerned, there is no scientific way of determining the relative emphasis that should be placed on each program or of establishing priorities for them. Only sound and prudential judgment can be relied on for this purpose. There is, moreover, no scientific test for determining a community's fiscal ability to support a given level of expenditures. Many factors are involved including the nature of the tax base, the income level of the residents, the tax position of the community *vis à vis* competing areas, and the general attitude of the people toward the transfer of resources from the private to the public sector of the economy.

A transit plan obviously cannot disregard these fiscal factors. Once the cost range (both capital outlay and operating expenditures) is determined, the program must be considered in terms of potential benefits and in relation to presently available and possible new sources of revenue.[7] The question must always be raised whether the contemplated program entails the commitment of resources greater than those which the community can realistically muster.

As Lennox Moak remarked: "It is foolhardy to develop a perfect transportation system only to find that charges necessary to finance it place the community in such a disadvantageous tax position that it is destined for the sheriff's sale."[8] One criticism that might be directed against most transportation studies is the failure to consider more systematically and in greater depth the fiscal relation of their proposals to the whole revenue structure of the urban area.

7. See in this connection Lennox L. Moak, "New Approach Needed to Finance Metropolitan Transportation," *Traffic Quarterly*, January 1959

8. *Ibid.*, p. 70.

The St. Louis transit proposals call for a total capital outlay of $340 million during the next twenty years. This sum does not include the costs of the expressway system now under construction or other road projects that will be financed from present bond issues, nor does it include the investment (as yet undetermined) that will be required if existing transit properties are purchased by a public agency. Of the total amount, $175 million is for the construction of the forty-two miles of grade separated roadways, including the downtown distribution loop; $50 million for off-street parking garages, and the balance of $115 million for improvements in streets, roads, and traffic control devices.

The report recommends that the costs of the rapid transit facilities ($175 million) be financed by the issuance of forty-year tax-exempt revenue bonds. The parking garages would similarly be financed by revenue bonds. To make up the deficit between anticipated operating surpluses and annual debt service, an automobile use tax of $20 would be levied annually on every passenger car registered in the area.

Assuming public ownership of the transit system, it is estimated that approximately fifty percent of the automobile use tax would be required as additional support for the rapid transit revenue bond financing. The remainder would be available to implement any deficit in debt service on the parking garage bonds and to help finance the recommended traffic and highway improvement program. As a special inducement to use public transit, passenger car owners who pay the automobile tax would be entitled to purchase a monthly transit pass for $10 instead of the suggested regular charge of $12.

What has thus far been said about finances indicates that local government will have to bear a large share of the cost of any significant transit program. It properly assumes that little progress will be made in solving the problem of moving people and goods until the general public is willing to regard mass transit as much an integral part of the transportation system as the expressways and the streets. It also presupposes eventual public ownership of the transit system—either ownership and operation by public authorities, or public ownership and private operation.

One or the other appears inevitable in our large metropolitan

centers. As the privately owned transit company in St. Louis conceded in its 1957 annual report, what must be done to turn the tide away from mass transportation cannot be done "so long as the transit system is a privately-owned profit-making enterprise." An investment banker's report on the fiscal aspects of the St. Louis plan takes the same view. It flatly states that the proposed rapid transit facilities cannot be financed by private enterprise except on the basis of transit fares that would defeat the entire purpose of the program.[9]

The capital expenditures contemplated by the transit and traffic plan are large. Amounting in all to approximately $225 per capita, they would almost triple the present bonded indebtedness of the area. When needed capital outlays for other public facilities such as schools, parks, libraries, and sewers are also considered, the sum is impressive. Yet transit expenditures must be viewed in relation to the vast investment of private resources that Americans are making in their urban centers.

If a sound circulatory system is essential for the protection of this investment—and there is every reason to believe that it is—energetic steps must be taken to achieve and maintain a satisfactory level of mobility within the limits of sound economic policy. The task ahead is not an easy one. Convincing an automobile-minded public of the need for large scale mass transit expenditures will require considerable persuasion—a persuasion that the sheer physical facts of decreasing mobility, if not reasoned perspective, will ultimately exert.

THE TRANSPORTATION DILEMMA

The St. Louis experience points up the serious dilemma that faces urban transportation reform. Transit needs cannot be divorced from other metropolitan demands. A satisfactory transportation program is not possible when the problems of streets, mass transit, parking, expressways, and general city planning are handled separately, or when its formulation and execution are built upon the separate actions of numerous municipalities, the county, state, and federal governments, and the transit operators.

9. *St. Louis Metropolitan Area Transportation Study,* (Report by W. C. Gilman and Company, 1959), p. 154.

Logically, there should be some politically responsible agency that can weigh the competing demands on public funds against both the needs and the fiscal capacity of the community. For only then can an intelligent, balanced, and equitable allocation of available resources be made. Unfortunately, no such agency exists in our metropolitan areas. To superimpose a separate transit authority on an already complex governmental pattern is to further compound the weaknesses that are inherent in the present system.

Yet such an authority may be the only politically feasible alternative since the residents of metropolitan communities have repeatedly demonstrated their unwillingness to accept a major restructuring of their governmental pattern.

Even in the case of a transit authority, there are few indications that metropolitan voters are prepared to entrust such an agency with sufficiently broad powers to establish an integrated circulatory system. This is true despite the fact that urban residents are clearly dissatisfied with existing conditions. Citizen attitude surveys conducted as part of general metropolitan studies in both St. Louis and Dayton revealed that traffic and transportation complaints far exceed those relating to any other service. The interviews also showed that a large majority of the respondents consider it the responsibility of local government to take remedial action in this field.[10]

The rapid increase in automobile ownership, the mounting traffic congestion, and the decline of mass transit services have created an attitude of public urgency. What is lacking is a sense of direction and effective leadership. The first deficiency will remain until some order and understanding emerge from the confusion that now surrounds the transportation problem. The second cannot be expected so long as there is no single political office or agency with authority to represent and speak for the metropolitan area as a whole.

Another facet of the transportation problem that most urban areas have been unwilling to face up to or even acknowledge:

The mechanics of moving people and goods is only part of the story. Steps must be taken also by local governments to influence

10. See *Path of Progress, op. cit.*, and Metropolitan Challenge (Dayton: Metropolitan Community Studies, 1959).

the demands on the circulatory system. City and regional planning must play an important role in attacking the congestion of moving.

Placing appropriate restraints on land use will in the long run be the only means of avoiding unsupportable transportation demands. The volume of traffic generated by the various densities and uses must be viewed in relation to the supportable capacity of the road and transit system. It is erroneous to assume that the capacity of this network can be expanded indefinitely to accommodate whatever land-use patterns may develop.

City planners are well aware of this problem, but the political structure of a metropolitan area militates against effective solution. It is useless to talk about rationally co-ordinated land use when the central city must battle to retain and enlarge its industrial tax base; when suburbs zone out low income workers even when they permit selected industrial development; and when the planning of a metropolitan community is parcelled out to a host of autonomous governments.

CONCLUSION

The defeat of the freeholders' proposals for a metropolitan district government has left the St. Louis transit plan without institutional means of execution. Like Pirandello's six characters in search of an author, it must now find a governmental agency to put it into effect. Up to this date, however, none of the political officials or community leaders has exhibited any signs of strong enthusiasm for the plan. Nor has any impressive public sentiment for the creation of a unified transit authority been demonstrated. These reactions are discouraging but not unanticipated. Major public changes involving huge sums of money are not brought about by a wave of the magic wand. Time, patience, leadership—and often catastrophe—are necessary before significant progress can be accomplished. What is important is that for the first time the St. Louis area has a comprehensive blueprint of its transportation and other public needs and the manner in which they can be met. The plans most likely will never be achieved in their entirety, but they at least provide guideposts for intelligent decision-making and stimulation for more modest action.

The St. Louis transportation study has given impetus to at least

two developments directed toward lesser solutions. First, the privately owned utility operating the major transit system in the area has offered to take over the smaller lines and create an improved bus system in exchange for local tax abatement. Second, a series of meetings for municipal officials has been sponsored by the city and county governments to consider the study's recommendations for co-ordinating traffic movement on the main arteries. These are small beginnings that offer little in the way of permanent solution; and one might argue persuasively that piece-meal action of this kind always delays the day of final reckoning. But if the public is unprepared to accept a comprehensive solution, lesser remedies, costly, partial and temporary as they may be, must be pursued. Action designed to cope with the problems that face our metropolitan areas cannot wait until ideological debates over public or private ownership of transit systems, or over local autonomy versus centralization, are settled.

Traffic Safety in the Nation's Capital Moves Steadily Ahead

ANTHONY L. ELLISON

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AS everyone who lives in Washington knows, there are two Washingtons. There is the official, glamorous Washington, the Capital of the United States, seat of one of the great powers of the earth. Then there is the Washington of those who live there: a relatively small, everyday city of 850,000 residents.

This city, however, is surrounded by a huge *metropolitan area* that has in the past decade experienced a population explosion: approximately 2,133,000 people live in the city and its suburbs today, an increase of forty-two percent since 1950. The livelihood of these people depends in great part on the hub city. For us, Bethesda and Seven Corners are part of Washington, although the former is geographically in Maryland and the latter in Virginia.

Strange as it may seem, not everyone in the Washington area

works for the federal government, although federal employment is the central pillar of the metropolitan economy. The point is that Washington is not only the nation's capital; it is also another American city with a municipal government and municipal problems akin to those of San Francisco or Cleveland.

One of our major problems is traffic safety. This article deals briefly with organization for safety and with driver-control in the nation's capital.

TRAFFIC CO-ORDINATING COMMITTEE

Management is a key factor in any economy. The management principle has now reached the field of traffic safety. Programming your state's resources for the most effective results in facilitating the flow of traffic and increasing safety on the road makes sense to us.

The best way for a government to handle the traffic safety problem is to co-ordinate all of its functions which touch on the various aspects of the problem.

We are told that this ideally is achieved through the creation of a top-level co-ordinating committee consisting of directors of departments concerned with traffic safety and headed by the chief executive or his immediate assistant. Although this ideal situation does not exist in all of the states, we can report that the District of Columbia has had since August 1, 1958 a traffic co-ordinating committee headed by the assistant engineer commissioner. (The District is governed by three commissioners appointed by the President of the United States.)

ORGANIZATION FOR SAFETY

Members of the committee are the top-level traffic safety officials: they include the director of motor vehicles, the chief of police, the chief judge of the municipal court, the superintendent of schools, the director of highways and traffic, and the chief prosecutor. This is our first team.

The committee meets regularly every two weeks, for not more than one hour. These officials are extremely busy persons. The committee handles inter-departmental problems of traffic control and traffic safety. It recommends to the board of commissioners how to improve traffic flow and the control of vehicles, drivers and pedestrians. Perhaps the most important thing it does is to prepare

each year a printed definite statement of the official traffic safety program of the District of Columbia.

Why is this so important? There are two reasons:

First, the printed program provides a co-ordinated basis of action by the official agencies.

Second, it provides a guide for citizen organizations who want to help the government by manifesting public support of its official action. How often do we ask citizens to help us and then fail to tell them exactly how to do it? This printed program is the answer.

The task of reducing to writing what one's goals are is also an effective method of clarifying the thinking about these goals. It also helps to create greater support for them, since they are clearly stated in print for everyone to understand.

Typical of our activities was the creation in 1959 of two special sub-committees. One, composed of the director of motor vehicles, the chief judge, the chief prosecutor and the chief of police, conducts a year-round analysis of the traffic regulations. This is done to maintain them in general conformance with the uniform vehicle code, which sets forth the best accepted practices in the nation.

The other committee, composed of representatives of the traffic engineering division, the police department and the safety education division, conducts an intensive on-the-scene analysis of traffic fatalities. This is not the usual accident investigation which our police do so well and so meticulously. This is a new concept: to determine what more might be done by either the public agencies or citizen groups to prevent the recurrence of similar tragedies.

Often it is found that the community could have done more. Neighborhood organizations such as the school, church, citizen association, parent-teachers association and others are asked to help the government create greater public awareness of the dangers involved in today's traffic.

So much for official co-ordination.

CITIZENS' TRAFFIC BOARD

Working closely with the government is our citizens' traffic board. This organization is almost thirty years old and has a semi-official character since it is appointed by the board of commissioners.

The commissioners established the citizens board to serve as a

public support organization, by exercising such leadership within the community as may be necessary or appropriate to develop public understanding and support of the official traffic safety program.

The citizens' board also has the task of advising the board of commissioners on traffic matters. For many years it was known as the commissioners' traffic advisory board. Since the District of Columbia is a federal jurisdiction, its residents do not have the vote. This board, however, is one way the commissioners can sound out public opinion . . . on traffic matters, at least.

The citizens' board is authorized to support the commissioners in obtaining or improving legislative, administrative, planning or enforcement measures which will result in the safer and more expeditious movement of traffic.

The board is authorized to accept voluntary subscriptions of business, civic, trade, professional, and other organizations and individuals to implement its function.

So much for public support.

METROPOLITAN AREA TRAFFIC COUNCIL

While Washington proper has only 850,000 residents, its metropolitan area numbers two million. Traffic in and around the nation's capital intimately affects this whole metropolitan community, city and suburb alike. More than 400,000 motorists cross the district line twice a day from the suburbs. This is double the number making the same trips ten years ago. The metropolitan area has:

—a traffic accident every thirteen minutes

—an injury from a traffic accident every 42 minutes

—a traffic death every 2 days

—an economic loss from traffic accidents in excess of thirty million dollars annually.

Over the years, local government leaders in the Washington area came to realize that much of the traffic control and traffic safety problem could be solved only on an area-wide basis. Therefore, in 1952, the District of Columbia, the States of Virginia and Maryland, the Virginia cities of Falls Church and Alexandria, the Virginia counties of Arlington and Fairfax, and Maryland's Montgomery and Prince Georges counties joined forces in the Metropolitan Area Traffic Council.

On the council, we have representatives of the local governing bodies, the county and city managers, officials of police, traffic, motor vehicle, and public works departments, judges, state officials and legislators, and others. To make the best use of available resources in the metropolitan area, the council, like the District's traffic co-ordinating committee, feels it must identify priority needs first. Its annual action program sets forth these needs clearly.

Once a year, representatives of public and private organizations from the entire area meet to express public sentiment at the annual commissioners' and governors' conference on metropolitan Washington traffic problems held in Washington, D. C. (The commissioners represent the District; the governors represent Maryland and Virginia.)

The current chairman is the engineer commissioner of the District of Columbia. We have two vice-chairmen, each the chief executive of one af the area jurisdictions in Virginia and Maryland. We achieve co-ordination in traffic programming and operations in the metropolitan Washington area in three ways. We carry out the recommendations of action program. We exchange information on mutual traffic problems which would be of value to all jurisdictions. We co-ordinate action whenever required.

All council action may be termed purely informal and completely voluntary. No one tells anyone else what to do. For an idea of the council's broad span of activities, let us take a look at the names of its standing committees: traffic engineering, police enforcement, driver licensing, vehicle inspection, courts, public education, legislation, civil defense.

The traffic problem in the Washington area is a monumental one. There is no easy solution. We cannot report spectacular progress and sensational gains made by the council. Whatever improvements have been made have been the result of patient, considered, and persistent action. However, the council can point to such results as:

—greater uniformity in police enforcement of traffic regulations

—establishment of areawide schools and courses in police traffic enforcement and traffic engineering for police officers and traffic engineers employed by Washington area jurisdictions

—an effective communications system and co-ordinated emergency procedures for heavy snowfalls and other traffic emergencies

—adoption of point system and re-registration of drivers in Maryland

—areawide co-operation in the "Traffic Court" television program, roadside safety posters, and other forms of traffic education

—annual organization of large-scale conferences on metropolitan Washington traffic problems to focus public attention on area traffic needs

—preparation of a uniform manual providing for standardization of the area's traffic signs and signals.

DRIVER CONTROL

In an automotive economy, the control of the motor vehicle and its driver has become a vital function of government, affecting the daily lives and welfare of more people than any other branch of government. This strategic role of driver licensing in any realistic attempt to prevent accidents is now better understood. The terrible toll of accidents and the growing injuries on our highways are not due alone to the increasing number of motor vehicles, or to deficiencies in road facilities. The attitude and habits of drivers are inseparable factors in these problems. As a result, we better understand the importance of driver-improvement activities.

The main purpose of our driver licensing is to grant the privilege of driving only to those who (1) are physically capable of safe driving, (2) possess knowledge of the rules of the road, and (3) have proper driving attitudes. The next goal is to remove drivers who have demonstrated they cannot or will not continue to drive safely.

It has often been said that in the long run, and for the money expended, no other activity in a state has such an effect on preventing traffic accidents as well-administered and soundly-developed driver license law. Compared to the needless waste of life, limb, and personal property in traffic accidents, the cost of sound driver improvement is relatively small.

Suspension or revocation of the motor vehicle operator's permit, to remove irresponsible and dangerous drivers from the road, is the crux of the program. This authority is the most important weapon of our officials who have to deal with the problem—even more so than a fine or a jail sentence.

There is little reason why we in the District should not have the most proficient driver licensing program in the United States. We are small geographically. We thus have a tighter control over our drivers than the larger states. This also permits us to introduce new methods with a minimum of inconvenience to the public, which would not be as easy in the larger states.

Our department of motor vehicles which conducts the driver licensing and control program, has a basic philosophy. That is that we cannot permit persons who are either physically or psychologically unfit to drive today's high speed vehicles on our crowded highways. So we make every effort to locate the unfit driver. Once we identify him we either re-train him or suspend his driving privilege.

There are four phases of the program of which we are rather proud. These are: our point system, our driver attitude test, our traffic school and our driver re-examination program.

POINT SYSTEM

Our principal technique of locating the unfit driver is the point system. The department of motor vehicles put the system into effect in 1953, placing the District of Columbia among its pioneers in the United States. Under the system, we keep a careful record of each driver's traffic violations and accidents. These come to us in reports of *moving* traffic violations from the police. We have nothing to do with parking violations. As each point is added to the driver's record, a clerk tallies the score for the previous three years according to a published point schedule.

When the motorist receives his first points, he also receives a friendly warning letter from us. A total of five points calls the driver in for a conference on safe driving with one of our hearing officers. If this does not discourage the violator and he gets eight points, he receives a notice of suspension of his permit. This suspension may last from two to thirty days. Subsequent suspensions are from fifteen to ninety days depending on the seriousness of the case.

When the driver gets to twelve points he is out! He loses his privilege of driving and his permit is revoked. Points received for individual violations are erased from the driver's record three years from the date of the offense. The driver improvement process is thus continual.

The operation of the point system has proved eminently fair and equitable. Little objection has been heard from the public, and you might say that objection is nonexistent today. The system has made the Washington public more safety-conscious than almost any other single program. Before we had the program, it was possible for a person to argue when told his permit was being revoked:

"This is the first I've heard about it! I always thought I was a careful driver. Nobody ever told me I was a bad driver."

Under the point system, that type of rationalization is no longer possible. The foremost safety value of the point system is educational. This is provided principally by the warning letter and the five-point personal conference, as well as the hearings at the time of suspension or revocation.

The main point we make with the driver is that we want him to drive safely. We do not want to take his permit away unnecessarily. When his point record accumulates, showing he is not a safe driver, we have no alternative but to take his privilege away.

We know the point system has made a significant impact on the community. Every day we receive telephone calls from drivers wanting to know how many points they have and what they can do to keep from losing their permits. There is no doubt that the public has accepted the point system for what it is, a method of reaching the driver who commits traffic violations and winning his cooperation before it becomes necessary to take him off the road.

ATTITUDE TEST

Our main objective in driver-licensing is to grant the privilege of driving only to those who are physically capable of safe driving, possess knowledge of our rules of the road, and have proper driving attitudes. We achieve this objective through our permit examination which we keep trying to improve and tighten up. On February 15, 1960 we instituted in the department of motor vehicles a new and more intensive test on the rules of the road. We screened our previous test of fifteen questions drawn from a pool of fifty questions. We subjected them to a thorough scrutiny and added fifty additional, searching questions. Now the daily test consists of twenty more difficult questions drawn from a pool of 100 questions.

Most important, we took a major step forward in checking the psychological qualifications for safe driving of new applicants.

Working with professional test experts and psychologists, we devised a test to give us a rough idea of the attitude of applicants toward safe driving practices. We knew we were pioneering and expected some hesitation or reservation about an investigation by us of mental outlook as a condition for the privilege of driving. We were pleasantly surprised, however, to find pretty general acceptance, with expressions of approval both in newspaper editorials and by high authorities. On television, for example, Dr. A. L. Chapman, assistant surgeon general of the U. S. public health service, praised our attitude test for drivers and said that "Washington is pioneering a good thing."

Now, in addition to the twenty questions on the rules of the road, we have seven questions on basic attitudes. The correct answers to these questions appear obvious to those who feel a sense of responsibility while driving. We find that about one out of every five applicants on initial examination is rejected for answering more than two of these seven questions incorrectly.

It is difficult to judge safe driving attitudes, but I am sure that no one with a sense of responsibility will disagree with the following basic propositions:

Accidents are caused by somebody's mistakes.

Most drivers lack the ability to control automobiles at high speed.

Driving while tired is almost as dangerous as driving while drunk.

And I think no careful driver can agree with the following incorrect attitudes:

A tired motorist should drive slowly until the drowsiness leaves him.

Risking your own life in a car is your own business.

Drivers who disregard traffic regulations should be punished only if they cause damage or injury.

If the applicant fails the attitude test, he must attend the District of Columbia Traffic School and then return for re-examination. At this time, he must take an even more difficult twenty-one-question attitude test and answer at least fifteen correctly. We have found that, after attending the six-hour course in traffic school, few fail this longer attitude test.

The District of Columbia Traffic School was established in Jan-

uary, 1948, and is conducted by the metropolitan police department, in co-operation with the department of motor vehicles and other agencies. The department of motor vehicles sends persons referred by its driver improvement program, as well as those failing the attitude test. These are the great bulk of enrollment in the school.

TRAFFIC SCHOOL

The judges in traffic court also refer certain bad attitude cases. The public prosecutor sends some. And the police youth aid division sends certain youngsters, occasionally.

Traffic school is conducted Tuesday through Friday in daily three-hour morning classes. Students attend two weekly sessions for a total of six hours. Two Saturday mornings a month are reserved for school-age traffic pupils, as they require more careful handling.

The excellent instructors of the school develop proper knowledge and attitude by discussing and demonstrating traffic laws, safe driving practices, accident causes, and courtesy in driving. The school's motto is: "Attitude—Skill—Knowledge: Key to Safe Driving."

To complete the course successfully, the student must pass a written final examination. He then is graduated with a written certificate. Since students attending the course are generally there as a result of their poor driving record, it is natural that at first they should be resentful and belligerent. The instructor's job is to overcome this resentment and instill in the students a genuine regard for traffic regulations and for the good sense of obedience to them.

We have letters from prominent citizens who attended the school, testifying to the fact that ninety-eight percent of our drivers could learn something they did not know before by attending traffic school. Most of the students come away feeling that they want to be better drivers henceforth. In fact, many volunteers ask to take the course. Unfortunately, we have all we can do to take care of those who need this extra training to keep their precious privilege of driving.

Many progressive licensing authorities feel that eventually we shall have periodic re-examination of all drivers—for example,

once every six years. Obviously, re-examination is a most effective control technique. Beyond the current information it gives about drivers, it has other educational values. The driver called in is alerted that the motor vehicle department is watching his behavior and is ready to do something about it. In most cases, this is all that is needed to change the driver from "not so good" to "not so bad."

RE-EXAMINATION OF DRIVERS

However, the public climate for re-examination of all drivers has not yet been established. We therefore pick out the drivers who seem to need re-examination most and concentrate on them. The good drivers we simply leave alone. The District of Columbia has for almost a decade pioneered in the re-examination of its drivers. We began with the re-examination of drivers who re-applied for a District permit after having had their privilege of driving revoked. These persons are required first to pass the regular three-part permit examination: the written test on the rules of the road, the standard vision test, and the standard road test.

In addition, they are submitted to a series of psycho-physical tests which delve further into their physical and mental ability to drive safely. One feature of this examination is the reaction-time test, which times the person's response to a signal to apply brakes or to turn the steering wheel right or left.

This re-examination is a perfectly normal one in driver licensing and has elicited no particular objection from the public. When some years ago we introduced the re-examination of persons sixty-five years of age and over, we did get an outcry from some older citizens. In short time, however, the benefits to the person became so obvious that the outcry died down and we now have nothing but words of praise from our older drivers. I cannot tell you how many persons of that group learn for the first time through re-examination that their vision is not up to par.

After a few years of this program, we decided to make the re-examination more stringent as the applicant's age progressed. This is our present schedule:

Age 65—Written test on rules of the road and vision test.

Age 70—The same, plus the reaction test, plus a physical examination by the applicant's own doctor.

Age 75—The same as age 70, plus the complete road test.

In September, 1959 we made further strides along the re-examination road. We then initiated requirement that all persons involved in two or more chargeable accidents within a three-year period be re-examined. They are given the complete permit examination plus the reaction time test. Under the point system, two chargeable accidents result in six points, not enough for suspension of the permit.

Finally, our most recent innovaton (February, 1960) is the requirement that all drivers who contribute to a fatality on the highways undergo a complete examination, both physical and mental, as a condition to retaining or regaining their privilege to drive.

This is the most thorough of our examinations, since the psychiatric part of it is conducted by our department of public health. Hereafter, when these persons can offer no logical explanation for their faulty driving action, we shall know whether any physical defect, or mental aberration, entered into the picture.

That is how the District of Columbia is organized for safety and how it attempts to control its drivers and stem the rising tide of automobile accidents.

Considerations in the Development of Limited Access Highways

LESTER HOEL

Mr. Hoel has been a lecturer in Civil Engineering at The City College of New York from 1958 to the present. During this period he attended the Polytechnic Institute of Brooklyn and received a Master's degree in Civil Engineering in June, 1960. He is a member of the American Society of Civil Engineers.

THE limited access highway has proved effective in moving vast numbers of motor vehicles used extensively for transporting people and goods. It is based on the idea that highway traffic will flow most efficiently if conflicting uses of the road can be eliminated. Thus, for example, many limited access highways are built solely for passenger vehicles, permitting entry and exit only at specified points. The road is also isolated from other roads by grade separations, and from opposing traffic by a midian.

A vehicle is able to proceed with no interference, with the exception of other vehicles moving in the same direction. If the road is of sufficient capacity to accommodate those vehicles desiring to travel between points of entry and exit, then this route will be most desirable to the motorist. Since this type of road has, for all practical purposes, been developed since the inception of the automobile, many aspects of it are not completely known.

In the most ideal case, the decision to build a limited access highway would be based on an evaluation of highway demand. This evaluation could be made by a study of traffic volumes, distribution of users, points of conflict, safety considerations and future demand. However, the problem is more complex because it is also necessary to reconcile other interests affected by the inclusion of this type of highway, but not directly benefited by it. It is obvious that if the effect on the community is detrimental, this solution to the traffic problem may be unacceptable.

Editor's Note: Mr. Hoel's thesis was written for the Polytechnic Institute of Brooklyn, New York.

Another problem concerns the right of the road user to isolate himself from the surrounding land or, stated another way, a property owner's legal rights to access to a road adjoining his land. Obtaining this right, when it exists, may require compensation; and the extent to which compensation is necessary may determine whether expediting traffic by limiting access will be possible.

This article discusses some effects of the limited access highway on the road user and the community; problems encountered in acquiring the right to limit access; reasons why limited access highways exist, and some of the aspects of financing these roads. Since the limited access highway is relatively new, conclusions will be only as valid as the extent to which studies in this area have gone.

However, by reviewing works already placed in operation, we are in a better position to justify further use of limited access roads, dispel (or confirm) doubts, fears, or reservations that various factions of the community may have; amend or revise plans to conform with existing needs, and facilitate planning for a better transport system.

REASONS FOR LIMITED ACCESS ROADS

The limited access highway is an established reality evidenced by the fact that many of them have been built. The exact mileage of limited access highways is not known. The Bureau of Public Roads reports total road mileage in the bulletin, "Highway Statistics," but does not list road mileage by degree of access. However, since World War II the mileage of limited access roads has increased because of concerted effort to solve the highway traffic problem. Of interest are the reasons why the idea of a road built exclusively for motor vehicles has received partial acceptance, when historically the road has been regarded as serving a wide variety of uses—including parking, loading and unloading, access for light and air in urban areas, and right of way for utilities.

One of the basic characteristics of traffic is that a major percentage of vehicle travel is concentrated on relatively few routes that comprise a minor percentage of the total road mileage in the United States. Various state highway planning surveys concerning concentration of traffic flow indicate that up to eighty percent of total highway travel occurs on twenty percent of the route mileage.

Statistics related to urban areas are even more startling. More than one-half of all vehicle miles are traveled on city streets comprising only ten percent of the total route mileage.[1] Analysis of this feature of highway travel leads to the conclusion that there is sufficient volume of traffic on a small percentage of the total road system to warrant the restriction of these routes to highway traffic alone.

Another major reason for building these specialty highways is that the necessary funds have been acquired through user taxation. The user, through the agency of government, assumes a degree of independence in paying for the road he uses, and those who do not use this transport medium do not support it. Local rural roads and urban streets are supported largely by general taxation, but the bulk of funds used to support state-administered highways is obtained from highway user charges.

Revenue is obtained from various sources. The motor fuel tax is the basic revenue source; the remainder comes from registration fees, mileage taxes on commercial vehicles, license fees, special local taxes and curb parking meters. Another source of revenue which could be classified separately, since its funds are used for a specific facility, is highway tolls. As it is the responsibility of each state to provide highway facilities, the extent to which a specific highway tax is used will vary from state to state.

There are many theories about the proper method of allocating highway charges; and there are those who oppose using highway charges solely for highway purposes. But, regardless of these viewpoints, this method has provided the greatest proportion of revenue used for building controlled-access highways to date.

The highway user charge has been accepted by the user and the community as a just source of tax revenue. It bears a close relationship to benefits derived, it helps diversify the tax system, produces revenue with certainty, and is not expensive to administer. The concept arose from the necessity to obtain revenue for highway purposes and to shift some of the burden of road finance from the general property tax. It may be that funds from user taxes have been expended almost exclusively for highway purposes because

1. Matson, Smith and Hurd, *Traffic Engineering*. New York: McGraw-Hill Book Company, Inc., 1955. P. 71.

the need for new roads has been so great that revenue derived from general taxes has not been sufficient to cope with highway needs and still leave a surplus.

Presently there is some controversy over the propriety of this tax. Some oppose this method of highway finance, believing that the highway should compete with other public needs for its support. They do not oppose a highway user tax but contend that the extent to which these funds are used for a highway should depend upon its relation to the general welfare, or at least its effect on other transport media.

A major contention, particularly in urban areas, is that new limited access highways attract more traffic to the road and away from other competing forms of transportation. The result is that the new road does not relieve the existing traffic problem but rather creates a new one, thus defeating its own purpose. The competing transit system is forced to reduce its service because of reduced demand, and a vicious cycle begins. G. E. Kidder Smith, of the American Institute of Architects, believes that the automobile should share in the transit crisis it has created, and suggests that a new subway line could be built in New York City with funds from automobile taxes.[2]

In this connection, it can be said that the use of highway funds for non-highway purposes is not great. Substantial use of road user taxes for non-highway purposes was concentrated in very few states and allocation of all road user revenues not now applied to highways would not have a broad effect.[3] The highway interests guard their sources of revenue and understandably so. Others claim that other needs are more pressing and the "rich" highway should support its poorer cousin, mass transit.

USER TAX VS. GENERAL TAX

In a discussion of the objectives and concepts of highway user taxation, Richard Zettel stated several reasons for distinguishing the method of highway finance from the general tax[4]:

2. Smith, G. E. K., "To Ease City's Traffic," *The New York Times*, April 2, 1959. P.30.
3. Bureau of Public Roads. *Highway Statistics 1956*. P. 34.
4. Zettel, R. M., "Objectives and Concepts of Highway User Taxation," Highway Research Board, Bulletin 92. P. 3, 4.

1. Since highway services are not distributed uniformly throughout society, and society does not deem it desirable to underwrite this uneven distribution of services through normal tax channels (as it does with education) . . . it appears that a convincing basis for user taxation is established solely on the grounds of public policy.

2. Since government is furnishing one element of a full-scale transportation service competitive in major respects with other transport media which are privately managed and financed . . . user charges may be designed to remove all or the major subsidy elements involved in government provision of highways, thereby promoting the economic allocation of resources.

3. The direct highway user tax aids in allocating funds to projects most wanted by the user. Taxation that bears directly upon those who demand services, furnishes a test of their willingness to pay. User taxation attempts to provide a basis for correlating effective demand for highway service with its economic cost. By this means, user taxation tends to promote the economic allocation of resources as between highways and alternative uses.

4. With the knowledge that the highway user tax will provide a consistent source of revenue, the comprehensive program of highway planning is greatly facilitated. Moreover, budgeting decisions may be based on the principle that funds should be used to provide maximum services for those who pay the bill, rather than by broader but less definitive principles of public expenditure.

The impact of the motor vehicle has been so great that immediate attention was focused in this area. A solution to the problem was made possible by motor vehicle owners' willingness to pay for new roads. As progress was made in providing better highway facilities, the impact of these roads was being felt in other areas. Limited access highways show this conflict in sharper relief. It is argued that a balance should be struck between highway building and other community development.

It is essential that the highway be integrated into the community plan. However, diverting highway funds that are not adequate for forecast demands will further hinder accomplishment of this nation's transportation goals, while not adding appreciably to achievement of other development objectives. The highway is the sinew that ties the community together. The manner in which this sinew is placed will determine how strong the community will be. The answer is not in diverting highway funds, but in using them where they can best serve the highway user and the community.

In discussing the user tax as a means of highway finance, mention should be made of highway tolls. The toll system can be considered a form of highway taxation earmarked for a specific facility. It has reappeared on the American scene in recent years and has been interpreted by some as a symptom of the inadequacy of existing methods of highway finance. Studies of the feasibility of toll road financing have produced varied conclusions. Some states have built toll roads with financial success; others have not. The document, "Toll Roads and Free Roads," on the feasibility of a nationwide system of toll roads, reported that construction of direct toll highways cannot be relied upon as a sound method of providing adequate facilities for the vitally necessary highway transportation of the United States.[5]

TOLL SYSTEM OF FINANCING HIGHWAYS

This method of highway finance, while aiding in the program of providing better roads, has limited application and must be judged with respect to each specific case. For this reason some of the points in favor of, or against, toll roads are listed[6]:

1. Toll roads are bond-financed. By providing funds in this manner the highway can be built as needed, quickly and efficiently.

2. Toll road financing counters diversion and dispersion. The road user pays for the road only when he uses it. However, toll charges may be considered as a form of double taxation. The motorist paying a toll charge for use of the road is simultaneously paying a motor fuel tax and other taxes for the use of his vehicle. It would seem that if toll financing were to be used more extensively to provide limited access highways, some tax relief would be warranted to users subjected to this double payment.

3. Toll roads are soundly engineered and built to high standards because the toll road must compete with existing free roads for funds to pay operating costs, bond interest and retirement. Consequently, free roads are often not as adequate as toll roads. The motorist must use poorly designed free roads to insure the financial success of the toll highway.

5. *Toll Roads and Free Roads*, House Document 272, 76th Congress, 1st Session, April 27, 1939. P. 4.

6. Davis, H. E., "Issues Involved in Toll Road Financing." A discussion presented to the meeting of the Highway Committee, Southern California Council of the California State Chamber of Commerce, February 14, 1951. Berkeley, California: University of California, Institute of Transportation and Traffic Engineering 1951, 14 pp.

Jorgensen, R. E. "Free Roads and Toll Roads," *Civil Engineering*, Vol. 20, September 1950. P. 40-44.

4. The toll highway has access points about ten miles apart and is primarily advantageous to long-haul commercial vehicles and vehicles traveling relatively long distances. Some contend that this is a special highway for a special type of user and would require a disproportionate share of the highway user tax if built as a free road. Toll roads have been built in so-called "corridor" states, to insure payment by out-of-state drivers. Urban areas with high property values, large volumes of traffic, and necessity for frequent interchanges are not suited to toll road operation.

5. Toll road and free road planning is often not integrated. It is clear that unless a highway system is built on the basis of long range planning the highway problem will not be solved. Ideally, toll roads should be considered in the light of the overall road network.

6. Toll roads are more expensive to build, finance, operate and administer than free roads, because complete access control is needed to insure payment of the toll. Degree of access to free roads may be based solely on traffic considerations and, in some cases, elimination of bridges and other costly appurtenances may be accomplished. Toll roads must be built on new right of way. Often this cost may be reduced by using existing roads for expansion as freeways. It should also be noted that federal aid cannot be used to build toll highways.

BENEFITS OF LIMITED ACCESS ROADS

The primary justification for limited access is the reduced economic cost that results from using this type of facility when other non-limited access roads are available. This justification is based on the premise that the user is paying for the road and should get the most for his money. Lower economic cost will result from reduction in travel time, decrease in accident frequency, and increase in vehicle operating efficiency. Less tangible benefits are increased driver comfort and convenience.

Various agencies have conducted studies to determine benefits derived when limited access roads are used. Savings are expressed in terms of dollars per vehicle mile or some other suitable unit. In general, these studies have shown that the user benefits when traveling on limited access highways.

The most notable attempt to list benefits in this manner is the Road User Benefit Analysis for Highway Improvements, compiled by the American Association of State Highway Officials. Data are limited to passenger vehicles in rural areas, and were published in

1952. A new volume is expected shortly which will reflect more current studies. An analysis of various road schemes based on cost and benefits is then possible and the limited access highway may be justified (from the users' point of view) on this basis. A notable example is an analysis of the benefits derived if the California Interstate System were to be improved to freeway standards.[7]

Studies have shown a marked reduction in the number of accidents per 100 million vehicle miles on fully controlled highways.[8] However, because accident experience varies with locality and the percentage of accidents reported also varies, no universally applicable value of accident benefits may be determined. Consequently, no value is reported by the AASHO. The California study reported an accident savings of 0.6 cents per vehicle mile on freeways as compared with city streets, based on insurance statistics and fatality rates applicable to that state.

It should be noted that often the highest accident rates are reported for partially controlled roads. This fact is attributed to the driver's false sense of security. Driving on these roads at speeds considered safe on freeways results in vulnerability to accidents at intersections and with patrons of roadside establishments.

The expression, "time is money," aptly applies to the study of user benefits. Surveys reveal that the highway user will willingly travel a greater distance, or even pay a toll, if a saving in time will result. It has also been shown that time savings result from the use of limited access highways. The AASHO recommends $1.35 per hour saved for passenger vehicles, based on $0.75 per hour per person. Three dollars per hour saved is the recommended value for commercial vehicles.

These values are more generally applicable than those cited for accidents. The value for non-commercial vehicles is the more debatable one, and is given as representing current opinion for a logical and practical value. There is some controversy over the validity of assigning a dollar value to comfort and convenience. From the user's viewpoint, such a value exists, since a motorist will travel a

7. Moyer, R. A., *An Analysis of Highway User Benefits on the California Interstate System Resulting from Completion of a Ten-year Full Freeway Program.* Berkeley, California: University of California, Institute of Transportation and Traffic Engineering, 1952. 9 pp.

8. Prisk, C. W. "How Access Control Affects Accident Experience," *Public Roads,* Vol. 29, No. 11, December 1957. P. 266.

greater distance on a freeway to avoid congested city streets, even if he saves no time. Values are assumed by the AASHO on this basis.

The value of vehicle operating-cost savings depends on variables. These include speed of travel, road surface conditions, number of stops, extent of grades and curves. Because these factors vary, specific analysis must be made of each proposed road. The AASHO presents operating cost data with respect to these variables.

In the California study, vehicle operating-cost savings for the urban interstate system were .52 cents a mile for passenger cars and 3.54 cents a mile for trucks. In considering the rural part of the system, it was assumed that for passenger and commercial vehicles the time saved was offset by increased operating costs from increased speed. In urban areas, however, benefits resulted both in time and savings in operating cost. On the rural system it was assumed that speeds would increase from forty-five to sixty miles an hour, while in urban areas the comparison was made between major city streets and urban freeways. User-benefits were five times greater on the urban interstate system than on the rural.

In concluding the analysis of highway-user benefits on the California Interstate System, Professor Moyer reported the benefits or savings during the given period would pay both principal and interest of the cost of the system and leave a remainder of almost one-half billion dollars.

There is a natural concern of businessmen, land owners, and townspeople as to the effect the limited access highway will have on their investments. Opposition confronts proposals that a freeway by-pass a town, or convert an existing boulevard to a freeway with frontage roads. This opposition comes from uncertainty that often surrounds this type of highway venture. In addition, some fear that if land values were to decrease because of freeway development, this would combine in effect with the large right-of-way lost to tax ro" and result in increased property taxes. Consequently, some studies have sought to determine the effect on economic well-being when a limited access highway is built.

SIGNIFICANT CALIFORNIA STUDIES

Unfortunately, studies of this sort require that the road be built and in operation. Also the fact that there are relatively few freeways,

and these fairly new, precludes a complete evaluation of the economic effect. In fact, as of 1958 there were forty-one economic impact studies under way in thirty-seven states.[9] Another aspect that hampers analysis is change in the community unrelated to highway development. This natural evolution makes it difficult to associate cause with effect. Nonetheless, it is believed and rightly so, that the highway does effect change over and above these natural processes.

INCREASED LAND VALUES

Results in the California Division of Highways' continuing *series* of economic studies on completed sections of controlled-access highways, are reported in "California Highways and Public Works." This series is significant because California is a leading state in freeway development. Research included the economic effect on commercial, industrial, residential and agricultural properties. Effects of by-passes were studied—a severe test because decreased traffic volume can be attributed directly to the new road. Results of this type of study revealed that removal of through-traffic from heavily traveled business streets resulted in business gains exceeding those of comparable commercial areas where no change in traffic pattern had taken place.[10] Where a limited access highway has been built through a community, with frontage roads provided, it was found that once equilibrium was established, there was no adverse effect on business. By these devices, the business establishments become more attractive to the local townspeople since traffic congestion is greatly reduced. The "highway trade," shown to be overestimated, is retained, when the highway-user has access to frontage roads, and is compensated for on by-passed routes by more accessible local trade and more attractive new capital.

As with user-benefits, community-benefits from controlled-access highways are lost if access is unrestricted. One state legislative report noted that results anticipated from by-passes had not materialized because of mushrooming ribbon development. It concluded that the highway department's use of the by-pass, under

9. Levin, D. R. "Report of the Committee on Land Acquisition and Control of Highway Access and Adjacent Areas," Highway Research Board, Bulletin 189, 1958. P.42.

10. Balfour, F. C. "California's Land Economic Studies along Controlled Access Highways," *Traffic Quarterly*, January 1958. P. 25.

these conditions, has very limited advantage, hardly justifying the expense involved.

An analysis of data in the exhaustive study of land value along the Gulf Freeway in Houston, Texas, led to the conclusion that in the five-year period after the route was well established, land values increased sixty-five percent more in dollar-value than similar properties in Houston lying distant from the freeway and served by the normal city system.[11] Similar studies in California warrant the generalization that increased property value reflects the beneficial effect of freeways on adjacent properties.

In a discussion of the effect of freeways on business and property values, Zettel showed their inter-relationship to user-benefits.[12] He pointed out that highway-user taxes shift to the ultimate user of the transportation service. For example, the price of a product consists partly of its transportation cost. However, the limited access highway has been shown to reduce costs; thus, in like manner, the savings that accrue to the user are also shifted. Since increased transportation costs will adversely affect business and property values, so will more efficient transportation *enhance* these values. It is clear that adding of user- and community-benefits to obtain "total" benefits is illogical. On the other hand, from the overall viewpoint, a transportation service that provides benefits to users will spur the economy.

The introduction of the limited access highway as a means of facilitating huge volumes of traffic flow has raised questions regarding the propriety of restricting access of abutting property owners, and the extent to which compensation may be required to acquire access rights. It has been established that the owner of property adjacent to a highway has certain rights because his property is so situated.

These rights are easements of access, view, light and air. The theory of these rights is that land purchased, condemned, or dedicated, was turned over to the public solely for use as a highway, and

11. Elder, H. W., "Land Value Along the Gulf Freeway in Houston, Texas." *Traffic Quarterly*, October 1952. P. 400.

12. Zettel, R. M. *Effects of Limited Access Highways on Property and Business Values*. A paper prepared for presentation at the 24th Annual meeting of the Institute of Traffic Engineers, Buffalo, N.Y., October 1, 1953. Berkeley, California: University of California, Institute of Transportation and Traffic Engineering, 1953. 15 pp.

that abutters retained right to adjoining land without intrusion, except what followed by use of the highway as such.[13]

It is evident that these precepts, having their origin in common law, can seriously hamper progress if applied stringently and out of context.

The various legal aspects of controlling access are complex in that they involve both federal and state constitutions and statutes, and include the multiple court decisions that clarify and interpret these laws. Clarification may come from direct highway cases or from other cases in which similar principles are involved. To further complicate matters, laws vary from state to state, and even in the same state, courts hearing similar cases have rendered seemingly contradictory decisions.

The two means by which the state may limit the right of a citizen are the police power and eminent domain. The police power is justified when exercise of it is for public health, morals, and safety, and for increasing public convenience and general welfare.[14] Land-use restrictions, traffic regulations, and building codes are examples of the police power.

In general, the police power may not be exercised when taking of private property is involved, although the taking may be in the public interest. Private property may be taken, however, under the doctrine of eminent domain, which is the superior dominion of the sovereign power over all property, which authorizes governmental appropriation of all or any part, by due process of law, for a necessary public use. Regulation by eminent domain requires just compensation for private property taken. Since abutters' rights are considered as property rights, they can only be taken under the doctrine of eminent domain.

The problem is to determine whether certain restrictive actions deemed necessary in constructing limited access highways actually result in taking of abutters' rights. Acquiring right-of-way is also accomplished by eminent domain. This aspect is somewhat more clearly defined, as land acquisition is also required for other types of public works. Consequently, this subject is not considered here.

13. "Rights of Land Owner in the Abutting Highway," 77 University of Pennsylvania Law Rev. 793 (1929).

14. Nissel, S., "Control of Access and the Police Power," Highway Research Board Bulletin 205, 1958. P. 30.

For purposes of analysis, the limited access highway is separated into two categories: roads built on new right-of-way and roads built on land used previously as a public way.

ANALYSIS

For the first case, it has been shown that there need be no problem of compensation if legislation specifically withholds access rights to abutters when a new road is legally opened.[15] This contention is based on the legal foundation of road-usage, dating back to early English and American law. Road usage in early days depended on grant given by the private land owner or state upon dedication of a new road. This grant was given by consent of the land owner, stated or implied. Cases were cited where it was shown that dedications of land for highway purposes have been made subject to restrictions of the dedicator.

For example, a dedicator may restrict the road for use of certain types of vehicle. In states where roads have been opened and no stipulation was made in the highway statutes that owners of adjoining land should not have a legal right of access, the courts have held that a vested right of access to the highway from adjoining land was given at the time of dedication of the road to public use. The simple legal device of prior restriction of access rights can prevent a windfall to property owners and unnecessary payment by the state.

Access rights on roads which are in existence must be extinguished prior to their conversion to limited access highways. Herein lies the problem which must be resolved in an equitable manner so the land owner will not be unduly penalized and the traveling public will not be prevented from using highway facilities which best suit its needs.

Since it is state constitutions that provide a frame of reference for the courts in access-rights cases, a distinction has been made between state constitutions that stipulate compensation only when property is taken, and constitutions that require compensation for damage caused by a public improvement whether or not property has, in fact, been taken.

15. Hutton, J. B., "Restricted Dedication of Rights of Way for New Expressways or other Limited Access Facilities," Highway Research Board Bulletin 38, 1951. P. 38-61.

About one half of the states are in each category.[16] The distinction is not as clear as it would initially seem, since courts have varied in the interpretation of their own constitutions. The distinction is further blurred by the fact that destruction of property is in effect taking, thus leading to the inference that there can be degrees of taking.

EASEMENT LIMITATION

In states compensating only for property taken, it would seem that the issue of compensation rests on a determination of what access rights exist, and if these rights can still be exercised after the construction of a limited access road. If, for example, an abutting property owner has a right to unlimited access to a road, then construction of a limited access highway would amount to a taking of property rights. Although it has been established that abutters have easements of access to an existing road, these easements are subject to certain accepted limitations. These are as follows:

1. The easement which has been created by grant is subject to the exercise of the intended use of the road to its fullest extent. This means that right of access is subservient to the public right to use the highway for its intended purpose.[17] However, the abutter's easement is superior to any changes in a road which are not consistent with its intended use. For example, the courts have ruled in favor of an abutter's claim that his rights were being taken by the construction of an elevated railway above an existing street. Cases of this sort cannot be applied as analogous to claims of abutters for restrictions caused them by virtue of the public use of the highway as a means of travel. Some courts have ruled that the construction of a bridge approach or viaduct was consistent with the intended use of the road, and abutters' rights were subservient to this use.

2. An abutter does not have the right to unlimited access at all points along the boundary of his property and the road. As a general rule, he may construct as many access points as are needed to maintain the property in the activity for which it was intended. Regulations on the character and number of access points may be made under the police power as long as they do not entirely or unreasonably restrict its intended use.[18]

16. Reese, H. B., "Legal Aspects of Limiting Highway Access," Highway Research Board Bulletin 77, 1953. P. 37.

17. Levin, D. R., "Legal Aspects of Controlling Highway Access." Prepared for the U.S. Public Roads Administration, Washington, D.C. Government Printing Office, 1945. P. 2.

18. Cunnyngham, W., "A Lawyer Looks at the Limited Access Highway," *Proceedings*, American Association of State Highway Officials, 33rd, 1947. P. 35.

3. A claimant against injury caused by a public improvement must show that the damage suffered was different in kind from that suffered by the public in general, and not only different in degree.

4. Ordinarily an abutter has no rights to the continuance of traffic past his property. Accordingly, any depreciation in land value caused by a public improvement, which results in a diversion of traffic, is non-compensable.

With those limitations in mind, it becomes clear that compensation in "taking only" states should not be very widespread. In fact, if these limitations are stringently applied, it would appear that only in cases where property is completely cut off from access to any road, or where it could be shown that property had been improved to conform to the existing road, or that a proposed improvement is out of character with the intent of the road, would compensation be justified. In all other cases, if it can be shown that the interests of the traveling public are above those of the abutter, any action taken to improve an existing road would not require the taking of property rights.

In recognition of the fact that property owners may be unjustly penalized by the creation of a public improvement, state constitutions have been amended to provide compensation where damage is incurred. This constitutional provision has been applied to highway access cases, and judgments are required in these states on whether damage has been sustained by property owners as a result of restriction of access. Determinations of this sort should be based on the general principles already outlined. However, amplification is in order on some of the situations which may arise.

BASES FOR DAMAGE CLAIMS

A property owner may claim damage due to change in access patterns in several ways. Among these are: reduction in the number of access points to a road, loss of direct access, and loss of view.

In the first case, determination of damage rests on the principle that access may be restricted provided that the intended use of the property is not hampered. If, for example, the number of access points on a farm or industrial property are reduced, it may or may not be possible to continue the use of the property as before. Should this type of restrictive action cause economic hardship, compensation would be warranted.

Loss of direct access to an existing road may result when frontage roads are provided for property owners who were directly abutting the existing road, or when a street is closed at one end. In both cases, greater travel distances are required to enter the road than were necessary before the conversion to a limited access highway. In addition, the *cul-de-sac* created by this means loses its attraction as a through-street and traffic is diverted. In these situations, damage might result in that customers might be required to travel greater distances to reach an establishment, an entrepreneur might lose potential business by virtue of diminished traffic past his doors, and certain industries might be inconvenienced in their operations.

Not all situations, however, involving loss of direct access would warrant compensation for damage. The diversion of traffic theory would eliminate claims for compensation based on decreased traffic on the road, and the principle of circuity of travel should be applicable to certain highway access cases. The courts have ruled that it is within the police power to regulate traffic.

This often requires certain restrictive actions on the movement of the motorist. Among these are the prohibition of various turns, use of one-way streets and other similar devices. These traffic aids often require longer travel and are known as inconvenience due to circuity of travel. Where the police power may be exercised, circuity of travel is non-compensable. The limited access highway serves a similar function as do traffic regulations in that traffic flows more efficiently and accident frequency is decreased. On this basis, it seems reasonable that abutters would not be justified in claiming compensation solely on the basis of greater travel distances required.

DAMAGE FOR RESTRICTED VIEW

It is true that the creation of a *cul-de-sac* could work hardship on some industries, for example, making it difficult for trucks to come in and out. On the other hand, there are definite advantages in residential areas where the *cul-de-sac* has come into use in a positive manner to eliminate through-traffic.

It is conceivable that the construction of a limited access road could result in restriction of view to abutters. This could arise from the construction of a highway bridge. If certain types of establishment are completely hidden from a road, damage might result.

However, if visibility is altered but not completely restricted, as is true on frontage roads, there may be no damage. Were damage to be judged for each change in visibility, then conceivably the state would be required to compensate for obstruction of view resulting from traffic signs or even landscaping. It is clear that the wisdom of the courts must be called to bear in cases of this sort.

The limited access highway has been an effective means of increasing the efficiency of motor transport. As with anything new, problems arise that must be worked out. These "growing pains" will be resolved so that the limited access highway will continue to be the efficient servant of the twentieth century.